61

K 6R

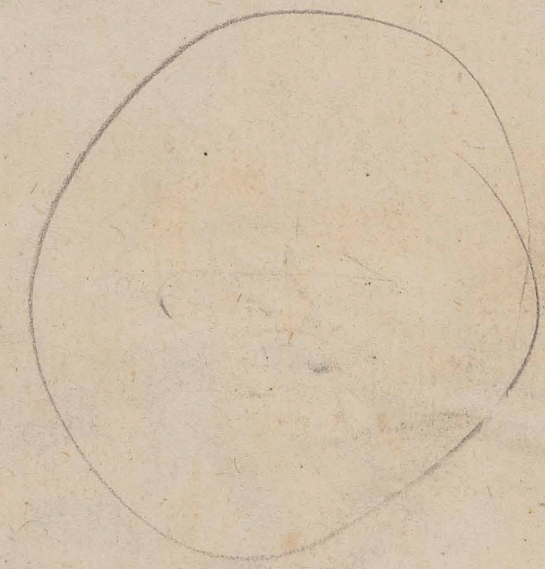
Oak Spring Garden Library

C. H. WILKINSON.

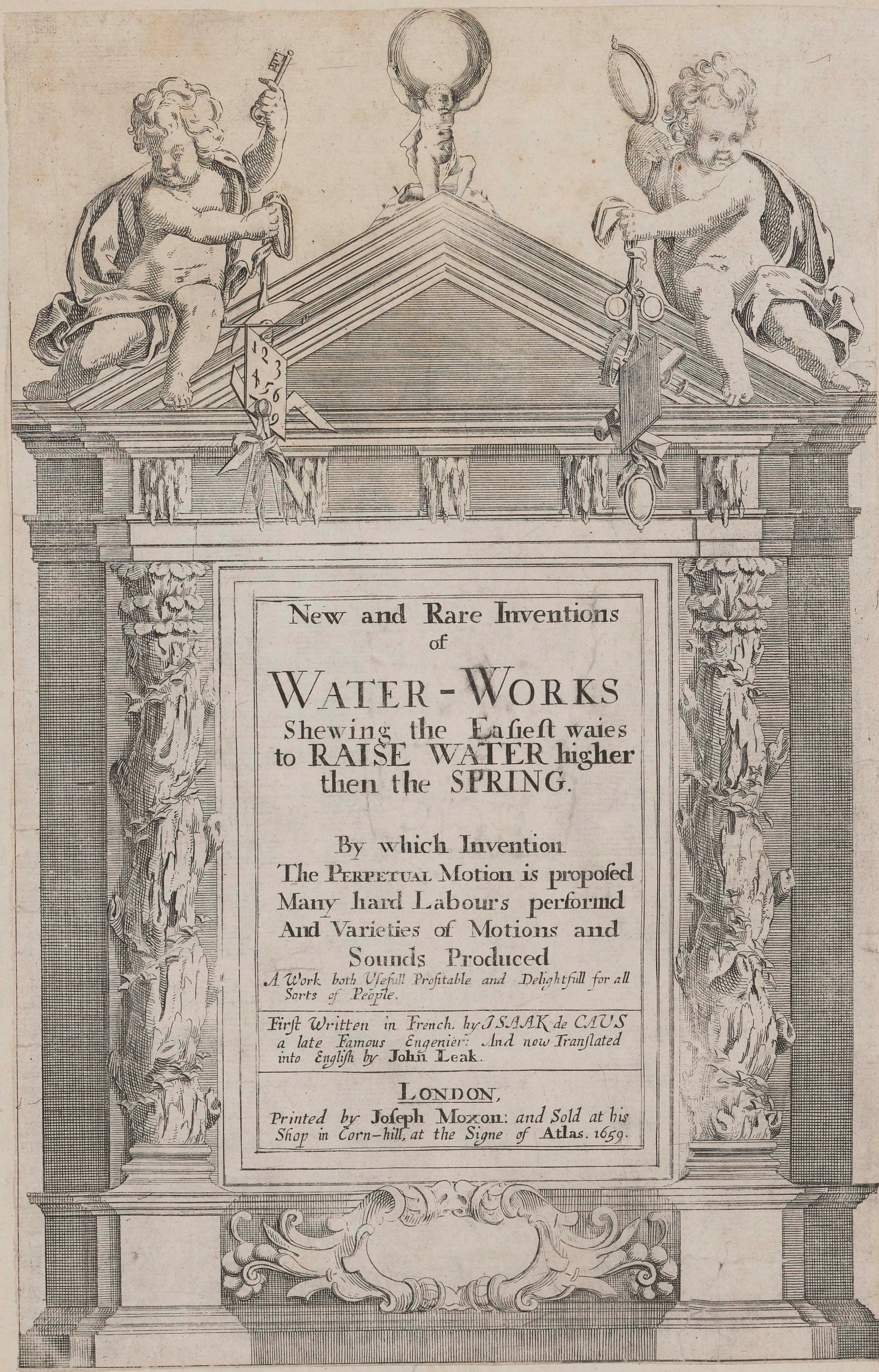
580 Caus (I. de) New and Rare Inventions of Water-Works, translated by J. Leak, *First Edition*, *26 plates* (*title mounted*) 1659

John Kynning

1726



174/a5/
£370
Wing 1527
Title p (stuck on sheet paper) + (4) + 34 pp. and 26 plates (plate 26 cut down and stuck on sheet of paper)



New and Rare Inventions of WATER-WORKS

Shewing the Easiest waies to RAISE WATER higher then the SPRING.

By which Invention
The PERPETUAL Motion is proposed
Many hard Labours performd
And Varieties of Motions and Sounds Produced

A Work both Usefull Profitable and Delightfull for all Sorts of People.

First Written in French, by ISAAK de CAUS a late Famous Engenier: And now Translated into English by **John Leak**.

LONDON,
Printed by **Joseph Moxon**: *and Sold at his Shop in Corn-hill, at the Signe of* **Atlas**. 1659.

fTS
144
C37
1659

THE PREFACE.

BEcause *The Raising of Water beigher then the Spring* (after the way principally intended in this work) seems to be opposite to the common received Opinion of all times, I have thought it not only sufficient to teach the Construction of the Engin proper thereto, but also (for more ample satisfaction) to premise certain Propositions to precede, in place of Principles; onely to make you understand the Effect of that Motion, by the Cause thereof; that so the way may be more accessible to the other *Phneumatike* Inventions; *viz.* [*Engins moving by the force of* Air.] To come to which, it must first be considered that all the *Elements* whether simple or mixt, have two principal motions, *viz. Natural* and *Accidental*.

The *Natural motion* is that whereby each *Element* searcheth and draweth it self towards the place assigned thereto by the Divine Providence in the Creation.

The *Accidental motion* is that which is moved by any outward Force, different from the First: Now although divers things seem to move contrary to their order,

without any *external* agitation: yet the reason is, that their contrary motion is caused, to hinder some other greater Accident. As for example, It shall be shewn that the *Water* to shun Vacuity, mounteth contrary to the ordinary Course thereof; because Vacuity is more repugnant to Nature then the contrary motion of that *Element* as shallbe seen by the principle propositions, which serve as a foundation of this Invention; which are founded upon this principle of Nature, *That there can be no Vacuity in the Elementary Sphear*, whereof the *Earth* and *Water* do supply the inferiour part, and the *Fire* and *Air* (which incompass them) the superiour part; and each of them are said *To be heavy or light, according as naturally they are near or further from the Center*; But in these four it will be necessary to have a regard as well to certain things whereof the *Air* and *Water* are capable, as to those wherein they cannot suffer Accident: as the *Water* which although it may be extended by the intermixture of *Air*, or atenuated and converted into *Air* by the means of Heat, which resolves it; yet nevertheless it cannot be prest, that is to say, that a certain quantity

of

of *Water* cannot be forced by compreſſion to be contained in leſs ſpace then its *Natural* extenſion: and the *Air* on the contrary may be reſtrained and put up, being preſt; or rarified and extended, being moved beyond the other accidents whereof it is capable. Theſe things ſhall hereafter be Demonſtrated by Propoſitions founded upon *Experience*; which I have thought to be more convenient for this purpoſe then to involve the Reader in a Labirinth of *Geometrical* Propoſitions; which (although moſt exact) yet are not altogether pertinent for Inſtructions in this Subject. As for example, If we ſhould build upon this Rule of *Archimedes, That the Superficies of the Water is Spherical* (*when it is not moved*) which Superficies hath for its Center that of the whole Earth; there will follow a Subjection that we muſt hold in the Demonſtrations; *viz.* That the Superficies of the *Water* is Circular, which (in the like caſe as is that whereof we ſpeak) is eſteemed plain of every one; and that, Firſt, Becauſe the difference is undeſcernable: and Secondly, Becauſe it cannot make a defect in any Oppe-ration whatſoever; (a liberty therefore which is not permitted in the *Mathema-*

ticks.) That therefore, with other reaſons have moved me to omit thoſe demonſtrations which ſeem to me to be too punctual for this purpoſe.

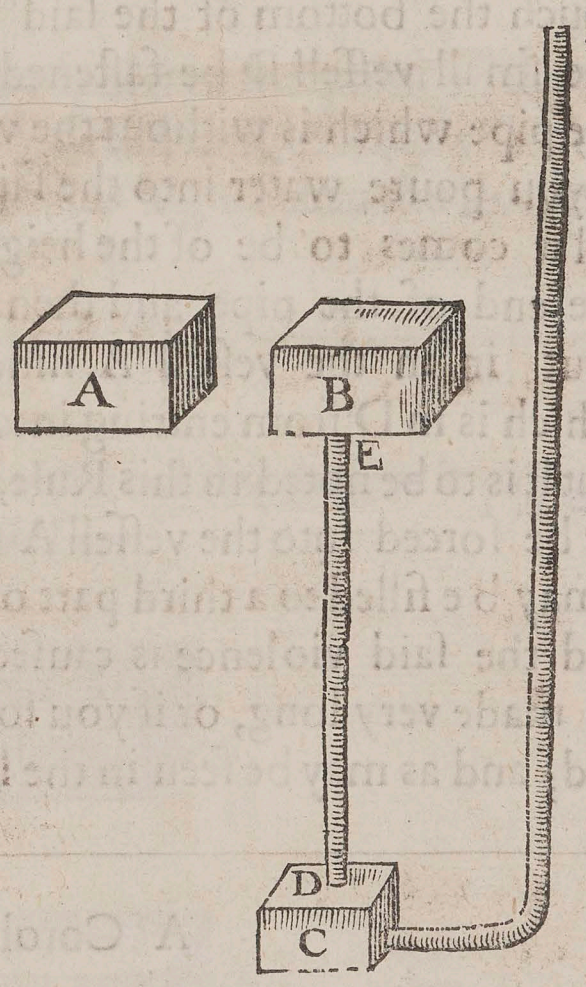
Note alſo that when I ſpeak of *Water*, I mean *Water* equally heavy, without making any difference, although in caſe of neceſſity there muſt be had a regard thereto; cheifly if the difference be ſuch as in the *Waters* of certain Rivers whereof *Plinie* ſpeaketh, wherein nothing will ſink to the bottom; as in the *Water* of the Lake *Alphaltite*, and in the *Water* of *Arethuſe* which runs towards *Siracuſe*, and that becauſe of their extream weight, which returns heavy things to the top, as *Quick Silver* doth the Mettal, which ſink not in it (although it be liquid) becauſe it is more weighty. And in this we muſt make a diſtinction, that Mettals and heavy Solids ſink in *Water* according to the figure they have: For *Copper*, *Silver*, and *Gold* ſinks not in ordinary *Water*, if it be beaten out in plates or thin leaves: but if it be contracted into a more ſollid form it ſinks forthwith to the bottom. But theſe and the like things I ſhall treat of in a Commentary upon the books of *Archimedes*, concerning *Weights*, and *Things ſinking in Water*.

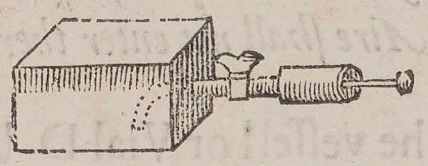
The *Theorie* of the Conduct of WATER.

PROPOSITION. 1.

The Aire may be preſt, but not the VVater.

To give an example whereof, let there be two veſſels A and B, of one form, matter, and bigneſſe, the which let be full of Water; it is moſt certain that in either of thoſe veſſells the Water cannot be preſt, ſo as the one of thoſe veſſells may containe the leaſt part that may be more then the other: but when they are only full of *Aire*, I ſay that the ſaid *Aire* may be preſt, and one of thoſe veſſells may containe more then the other: which ſhalbe thus Demonſtrated. Let the ſaid veſſells A and B be made very cloſe on all parts, and at the bottom of the veſſell B let there be a ſmall hole E, to which the pipe E D is faſtened, the other end thereof D is faſtened to the upper part of the veſſell C, the which is alſo made very cloſe one every ſide, and containing about a third part of the veſſell B, and to make the Water enter therein with force, it will be neceſſary to faſten the pipe F neer to the bottom of the veſſell C, the which ſhall be made as high as may be, that it may give ſo much the more violence to the Water, the which entring the ſmall veſſell C, ſhall make the *Aire* that is therein to aſcend into the veſſell B, the which ſhall containe more *Aire* then A by the quantity which was in C, and ſo the *Aire* ſhall be preſt in the ſaid veſſell B; the which may be ſeen if you make a ſmall hole in the ſaid veſſell, by the which the ſaid *Aire* ſhall come forth with violence. But if you





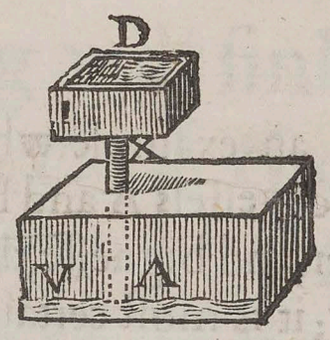
pierce

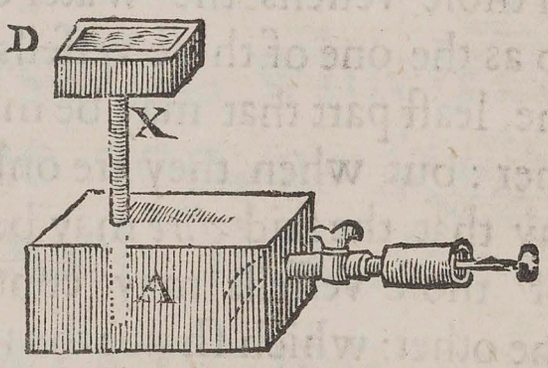
pierce the veſſell A there will not bee the ſame effect, becauſe in it the *Aire* is not preſt. But it is here to be Obſerved, that although the *Aire* may be preſt, it is but only to a certain degree, which is about a third part: and for proof thereof, If the veſſell C were as great as B, it were impoſible that the ſaid veſſell ſhould be filled with water, but that the *Aire* ſhall often break forth, and that becauſe B is not capable to contain ſo much *Aire:* therefore let it be held that the *Aire* may be preſt in a cloſe veſſell to a certain degree. There is another way to force the water with violence into the ſmall veſſell, by the means of a Seringe, as in the ſecond Figure.

PROP. 2

The water cannot enter into a veſſell, but there muſt come forth as much Aire, except the water be ſent in by force.

TO Demonſtrate this, let there be a veſſell as A, and let the pipe X be faſtned in the cover thereof, ſo that it may neer touch the bottom of the ſaid veſſell; and let the ſmall veſſell D be faſtened to that end of the pipe which is without the veſſell: Then if you poure water into the ſaid veſſell A untill it comes to be of the height V, which is the end of the pipe, and then the *Aire* being ſhut in in the veſſell **A**, hinders the water which is in D from entring into the veſſell **A**. But it is to be noted in this Rule, that if the water be forced into the veſſell A with violence, itmay b e filled to a third part or thereabouts, and the ſaid violence is cauſed if the pipe X be made very long, or if you force the water in with a Seringe, as hath been ſaid; and as may be ſeen in the ſecond figure.

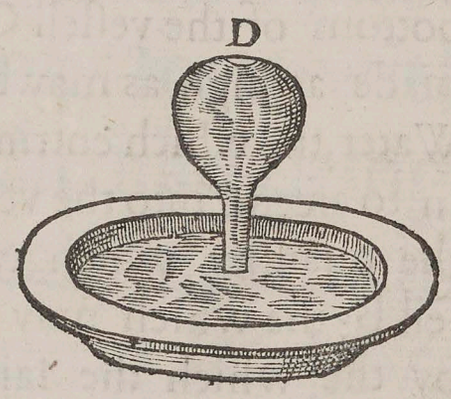




A Corollarie. PROP. 3.

It followes by the contrary reaſon that if a veſſell be full of water it cannot be emptied, ſo that the Aire ſhall not enter therein.

AS let the veſſell or Vial D be propoſed, which let be full of water, and let it be reverſed, ſo as the mouth or neck may touch the water, which ſhall be ſet under it in a veſſell; it is certain that although the mouth of the ſaid Viall be downwards, no water ſhall run out, becauſe the *Aire* cannot enter to ſupply the place of the water that ſhould run out.

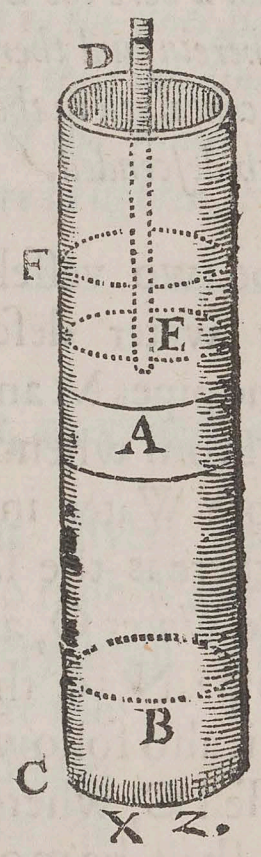


PROP.

PROP. 4.

There can be no vacuity.

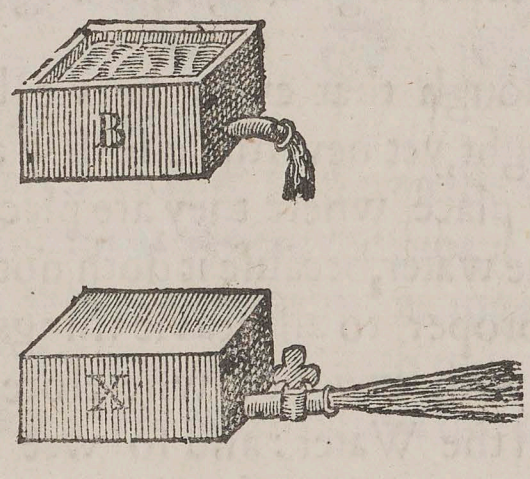
THis is that which hath been ſaid in the *Preface*: the proof wherof may be gathered from the foregoing *Corollarie*, and divers other examples, whereof here is one: If you have a Copper pipe B, whereof the end C is in the water, and let the other end D be open, to the end that the Peſtle A may be put therein, which ſhall be like to thoſe which are uſed for Pumps and Forcers of water; and that the ſaid end A, well invironed with leather, to the end that putting water in E it may not run through to B; then if A be raiſed to the point F, the water X which is levell with the point C, ſhall aſcend to B, to ſupply ſo much place as is between A and F; ſo the water aſcends higher then the levell, that there ſhould be no void place left in B.



PROP. 5

If the Aire be preſt in a veſſell wherein there is water, and that you give it paſſage by ſome pipe, the ſaid water ſhall come forth with violence.

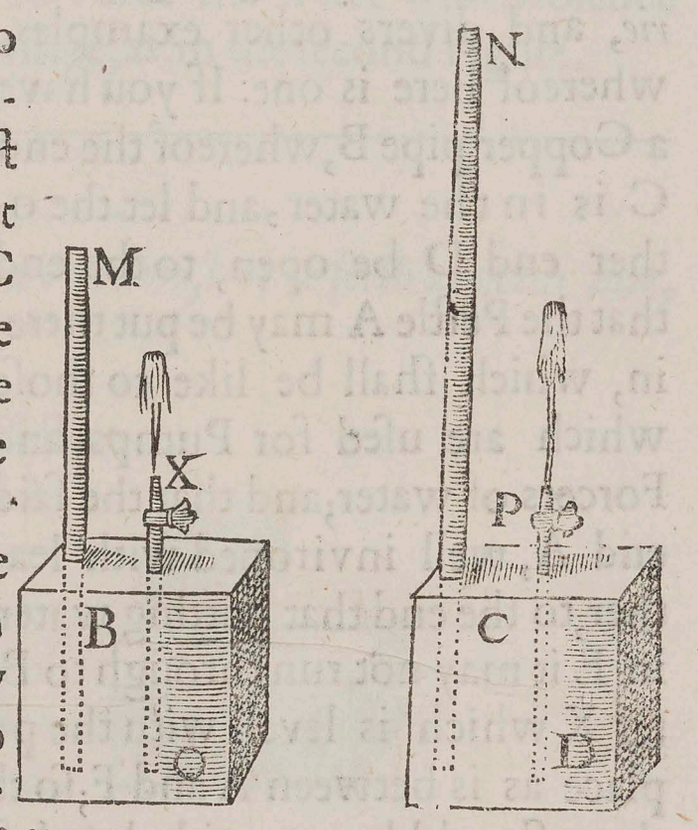
IF the *Aire* be preſt in the veſſell X, (let it be by means of a Seringe or by a pipe, as hath been ſaid before,) it is certain that then when the water hath paſſage, it comes with a great deale more force then if it came forth from an open veſſell, as B.



PROP. 6.

If the water Deſcends with violence into two equall veſsels, there ſhall enter more water into that veſsell where the water Deſcends from the higheſt place, and the Aire ſhall be more preſt therein, and there ſhall be the ſame rate or proportion between the quantity of water contained in thoſe veſsells, as there is between the heights from whence the Water hath deſcended.

LEt there be two veſſells B and C, to whichthe water deſcends with violence by the pipes M and N, the longeſt of which is N, From whence it follows that there enters more Water in the veſſell C then in B, and there is the ſame rate of the Water D to the Water O, as there is of the length of the pipe N, to the length of the pipe M. And it alſo followes from hence, that in the veſſell C, where there is more Water, the *Air* ſhall be more preſt then in B, and the effects thereof may be ſeen by the ſmall pipes P and X, of the which two P caſts the water higheſt; becauſe the *Air* is more preſt in the veſſell C, then in the veſſell B, in the ſame manner as before wee may proportion the *Aire* of the two veſſells to the heights of the Water ſpringing forth by the ſmall pipes P and X, the which ought to be equall.



PROP. 7.

All heavie things whatſoever weigh more in the Air then in the VVater.

ALthough that every heavie body hath alwaies in its ſelf its proper weight, yet nevertheleſſe they are alſo conſidered diverſly, according to the place where they are placed, as it is certain that wood weighs nothing in the water, becauſe it doth not deſcend towards the center of the Earth, which is proper to all heavie things; But if it be in the *Aire*, it falls towards its center with weight: wherefore wee may ſay that it weighs more in the *Air* then in the Water: and ſo wee may ſay of all Bodies, although they are heavier then the Water, for although they fall towards their center of gravity in the Water, yet it is not with ſuch ſwiftneſs. It is not neceſſary to ſhew here by what quantity the ſaid heavineſs is more weighty in the *Aire* then in the Water; ſending the Curious to the Books of *Archimedes*, concerning things falling in the Water: where it is demonſtrated that heavy things weigh more in the *Aire* then in the Water, by the quantity of Water, which is equall to them.

A *Corolarie*

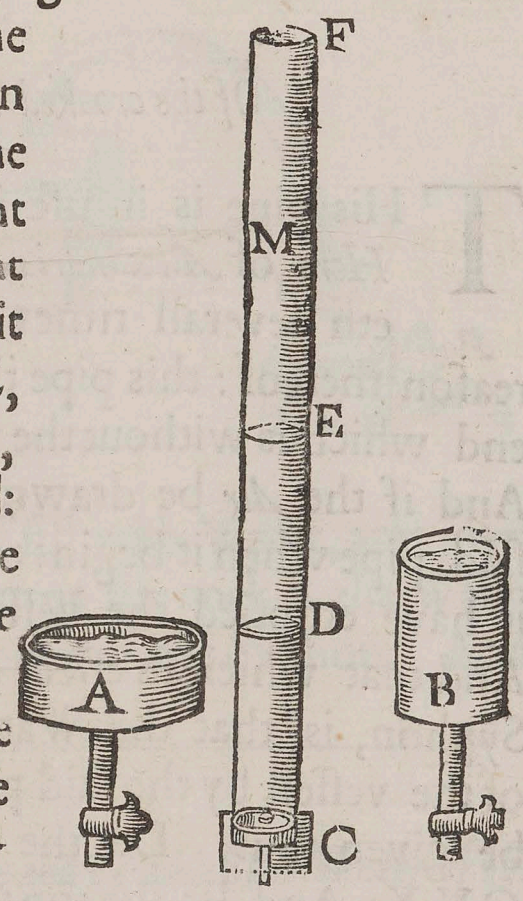
A Corollarie.

It is here to be Obſerved that Waters are of diverſe weights, and they ſay that on the Territories of Cara *in* Spain, *there be two fountaines, in the one of which divers things being put, ſink to the bottom; the which being put in the other, float at top. They report the ſame thing of the* Lake *of* Sodome, *and of the fountaine of* Arethus. *The which effect comes to paſſe by reaſon of the weight of the Water: and from hence wee may infer, that one and the ſame thing weighs more in lighter Water, then in heavier VVater.*

Prop. 8.

Water weighs upon that which ſuſtaineth it, according to its height.

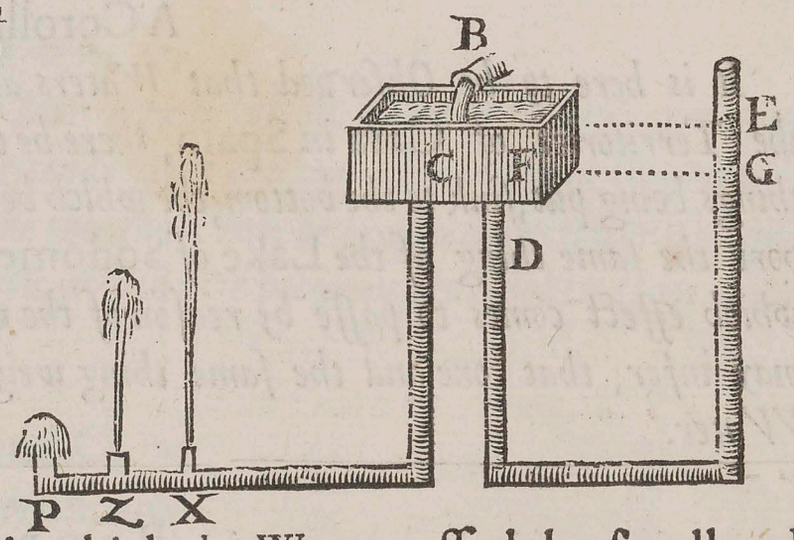
I Have given this example, becauſe that divers deceive themſelves upon this ſubject, which have thought to raiſe Water, not conſidering the weight, when it comes to be raiſed very high. That which is then to be underſtood by this Propoſition, is that the ſucker C, being at the end of the pipe M, to ſuſtain the Water which is within the ſaid pipe, that the Water weighs upon it according as the height thereof ſhall be in the pipe. As let us ſuppoſe that the Water be in the pipe as high as D, and that it weighs 20 pounds, if we fill the ſaid pipe to E, which is as much again, it ſhall weigh 40 pound, and if we double it againe, it ſhall weigh 80 pound: And according to the greater or leſſer height of the Water within the pipe M, the ſucker C ſhall be harder or eaſier to lift up; which is that which ought to be conſidered, when the water is to be raiſed very high: to the intent to proportion the thickneſs of the pipes to their height: ſo as the Water that is in them may not be too heavie for the moving force. It is alſo to be Obſerved that in Ciſterns the force of the Water ought not to be taken from the bottoms where the pipe is ſouldered, but from the ſuperficies of the VVater which is in them: as may be ſeen in the Ciſterns A and B: wherein the VVater that is in B hath more force, becauſe it is higher then A, although the pipes are of equall thickneſſes and lengths.



Prop. 9.

The VVater naturally aſcends to the levell of the place from whence it did deſcend.

THis proportion is very intellegible, and is as much as to ſay that if there be a Spring as B, the VVater whereof enters into the Receiver C, and if there be a pipe as D deſcending right down or obliquely, the

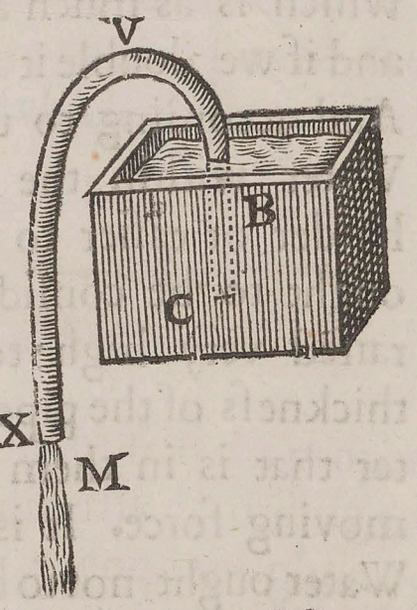


VVater ſhall aſcend therein to E, which is the levell or height above of the veſſell C: and if the ſaid veſſell be not full but to the point F, the Water ſhall not aſcend through the pipe D, but to the point G, the levell of the ſaid point F, and although the pipe comeing from the veſſell C, be not drawn ſo high, if the end of the pipe through which the Water paſſeth be ſmall and the pipe great, it ſhall aſcend to its levell; but according as the ends of the pipes through which the ſaid Water paſſeth are greater, ſo the Water is deficient in its height. This may be ſeen in the figure by the ſmall pipes X Z P.

Prop. 10.

Of the crooked Pipe, by which the VVater is darwn forth.

THis pipe is in uſe in divers places, and hath been treated of by *Hero* of *Alexandria*. But it muſt not be here omitted, becauſe it falleth ſeverall times in uſe for our ſubject, and alſo to underſtand the reaſon thereof: this pipe then is called by divers a *Syphon*: and hath that end which is without the veſſell longer then the other; And if the *Air* be drawn forth which is within the ſaid pipe when it begins to run, it ſhall not ceaſe untill it have emptied the veſſell as high as the other end; And that which in effect may ſeem ſtrange of the ſaid Syphon, is, that the Water riſeth higher then the top of the veſſell by the ſaid pipe: the reaſon whereof ſhall be given thus. Let the veſſell be B, and the Syphon C V X. And let the top thereof be V and the end V X longer then V C, then when the *Air* which is in it, is drawn forth by the end M, the Water of the veſſell B enters therein to fill the place. Now it being full the Water contained from V to X being more heavie then that from V to C, makes it run towards M. And as that Water cannot run forth of the pipe, unleſs there enters ſomething therein to fill the place, and the *Air* cannot enter the water by any place of the veſſell B, the Water ſhall aſcend untill it comes to empty it ſelf to the height of C, and then the *Air* entring therein the courſe of the water ſhall ceaſe.

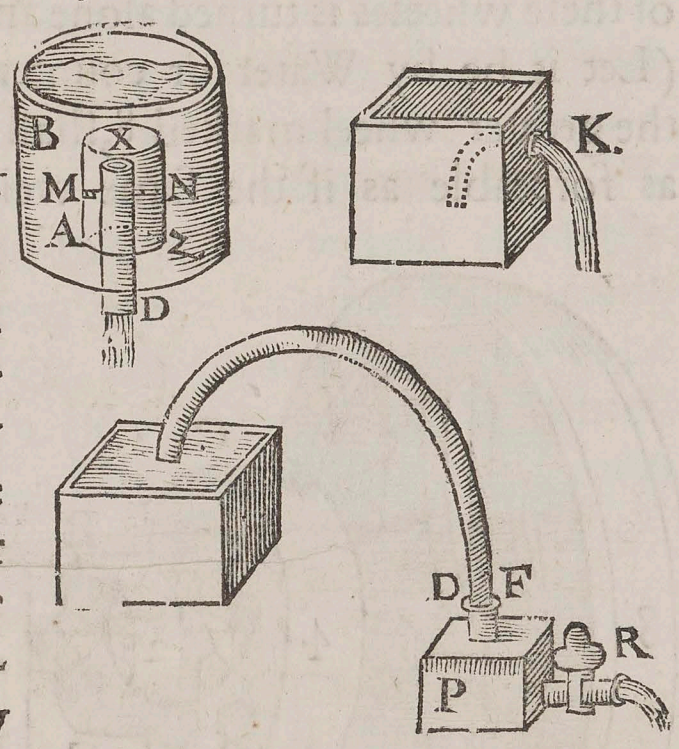


Prop.

PROP. 11.

Of another kind of Syphon: *and how the Air may be drawn forth by the means of another vessell.*

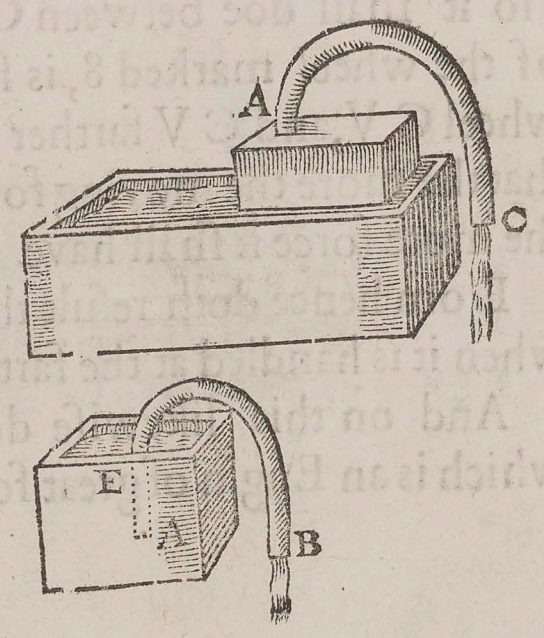
THere may be made divers kinds of Syphons, but behold here one which seemes to be most different: which nevertheless depends upon the same reason with the former. Let the vessell be B, and let the pipe D C be souldered to the bottom passing through it: Then let one end of the pipe A X Z be put about it, so as the end X may be closed and souldered so as the water may not enter but by A Z, but A Z must not touch the bottom: therefore the pipe A X Z shall be fastened to the pipe D by two small tennons M and N, and it must be observed that the said pipe A X Z ought to be made of such a thickness that the Water contained between it and the pipe D may be equall to the water which is in D, the which being done the Water may be drawn forth by D, and performe the same effect as the former. But if either the one or the other of those Syphons containes so much *Air* that it cannot be drawn forth by aspiration, there shall be made a vessell as P very close and souldered on all parts, and it shall have one end F to joyn with D, the which vessell fill with Water, and joyn F and D together without taking *Air*, then if you turne the cock R the Water that runs forth from the vessell P shall draw the *Air* of the Syphon. And make it run.



PROP. 12.

The VVater runs equally by the means of a Syphon, if the end by which the Water of the said Syphon ascends doth only touch the Superficies of the water of the vessell.

BEcause that in the foregoing pipes the Water runs not equally, being slower at the end then at the beginning. It shall be shown in this example how it may run equally, that is if to the end A of the pipe A C a small vessell of any matter be put, let it be what it will, so it may float upon the Water, and the end A of the pipe A C be put through the same, so as the end may touch the superficies of the Water, it is certain that the end C shall run equally, which is not so in other Syphons, the which run alwaies swifter at the beginning then at the end.



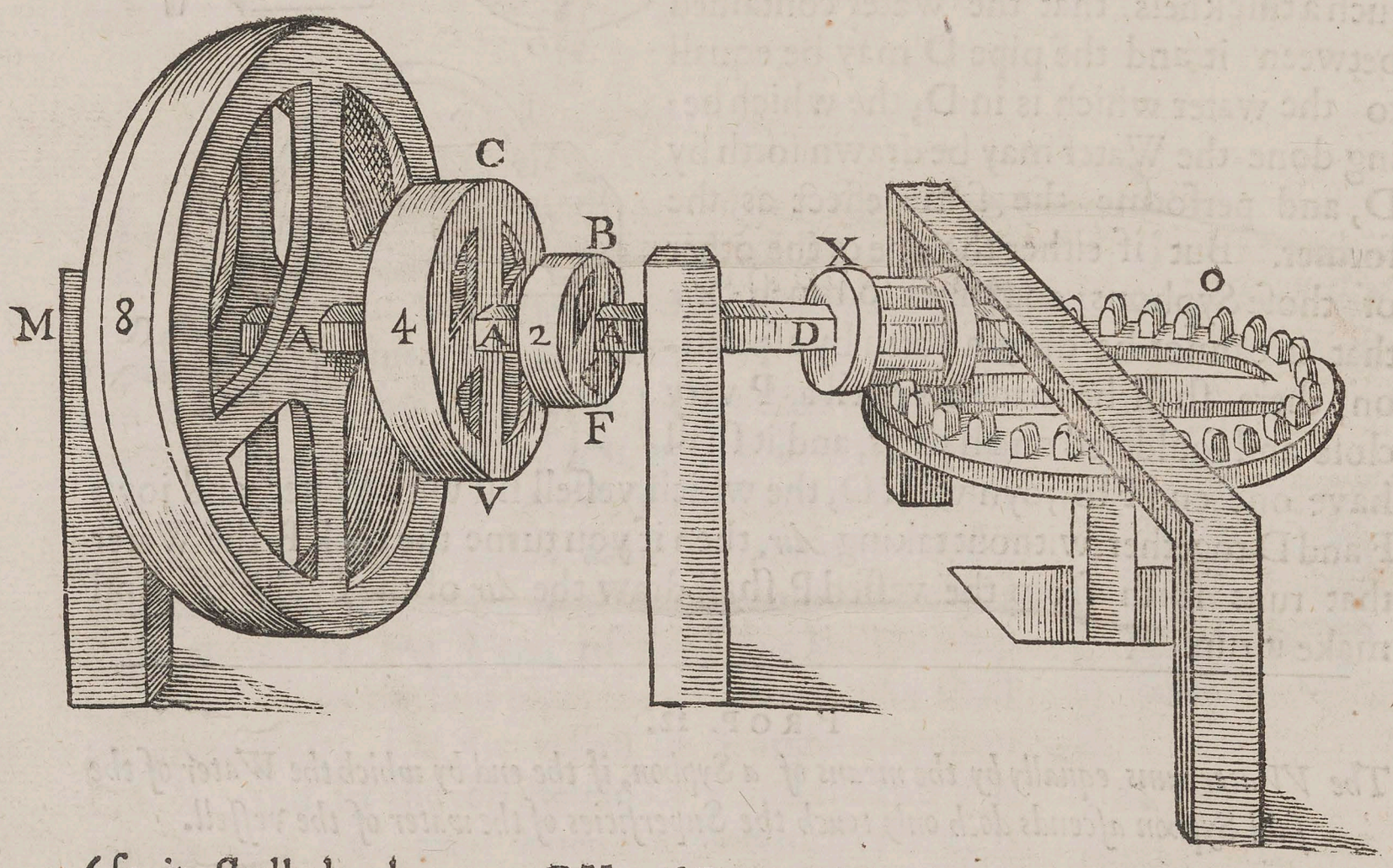
PROP. 13.

PROP. 13.

The farther that the moving force is distant from the center of motion, the more force it hath.

The force moved with the wheel X O is understood by a Tree or Axis marked with D A M.

The force moving is represented by the three wheels marked with B F, C V and 8, the which are of several magnitudes, that is to say B F of two feet in diameter, C V of 4 feet, and the largest of 8 feet. I say that if each of these wheeles is turned alone and by it self, by an equall or the same force, (Let it be by Water or counterpois) that the same weight or force put to the greater wheel marked 8, shall make the tree and wheel X O move 2 times as forceable as if the same weight or force were put to the wheel C V:



(so it shall doe between C V and B F) and that because the circumference of the wheel marked 8, is further distant from the center of the tree then the wheel C V, and C V farther distant then B F, therefore it shall be concluded that the more the moving force is distant from the center of motion, so much the more force it shall have.

From hence doth result the force of the *Leaver*, the which hath more force when it is handled at the fartheſt distance from the burthen.

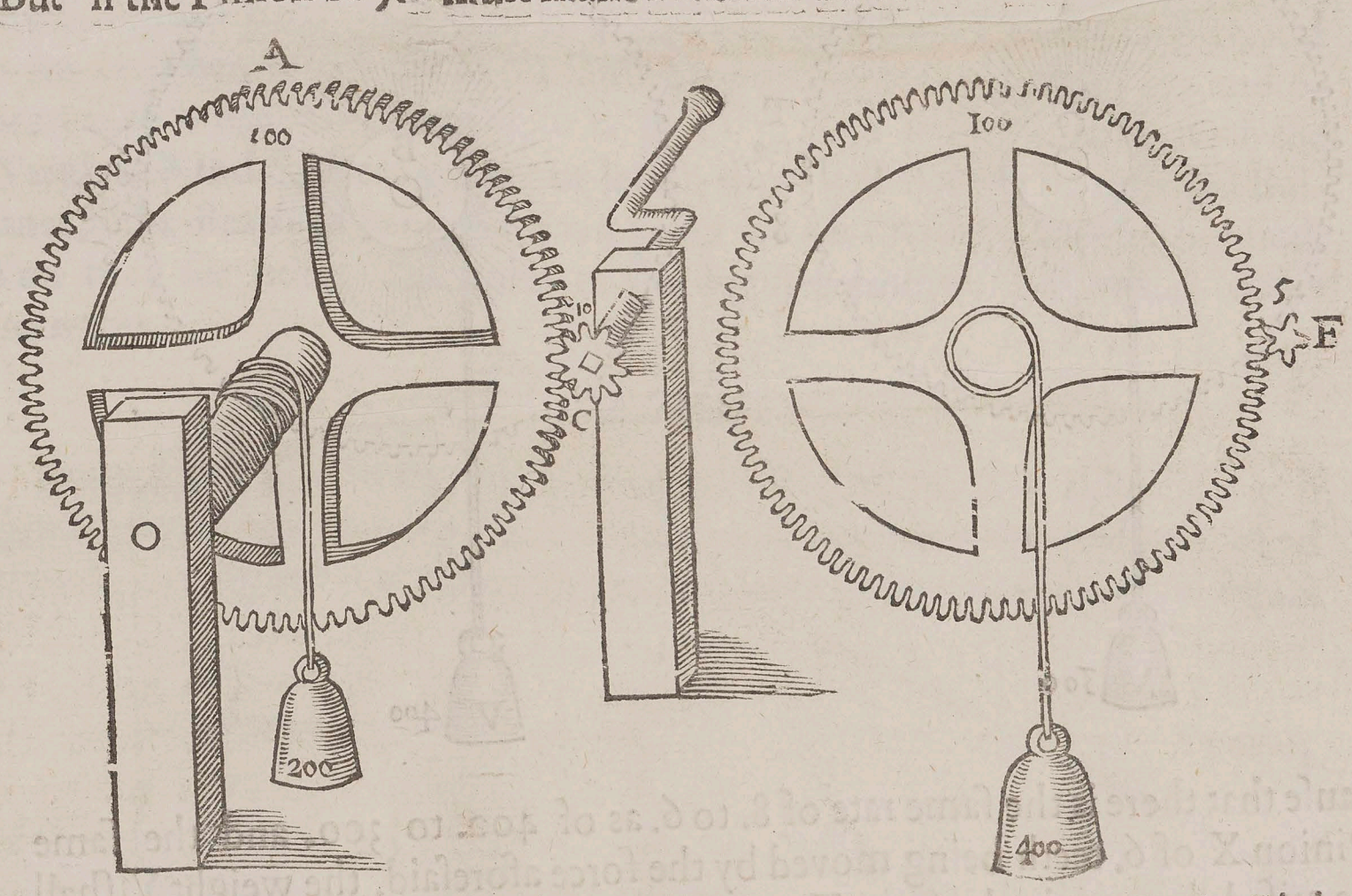
And on this likewise depends the reason of the tree of the *Screw press* which is an Engin of great force.

PROP. 14.

PROP. 14.

If a Wheel be turned by divers Pinions, to whose Axis any weight be fastened, the lesser Pinion shall be capable to move the greater weight: but it shall not turn the Wheele so fast: and there shall be such rate or proportion of the quantitie of one weight to the other, as is the difference of numbers of the Teeth of the said Pinions: and the times of raising the weights shall have also the same proportion the one to the other.

LEt the toothed Wheele be A, the number of Teeth whereof let be 100. if this Wheel be led with divers Pinions, and the same force moves them, that Pinion shall give the most force to the Wheel to raise any weight whose number of teeth is the least: But the said Wheel shall turn slower, as hath been said. And herein behold the Example, If the Wheel A be turned by the Pinion C of 10. Teeth, and be capable to raise a weight of 200. and instead of the Pinion of 10. teeth, it be turned by a Pinion of 5. then it the force to raise 400. But as the weight is double in gravitie to the first, so also it shall be as long again a raising up, because the Pinion being 10. and the Wheele 100. the Pinion ought not to be turned above 10. times to make a whole turn or revolution of the Wheel: But if the Pinion be 5. it must make 20. turns before the Wheel makes one,



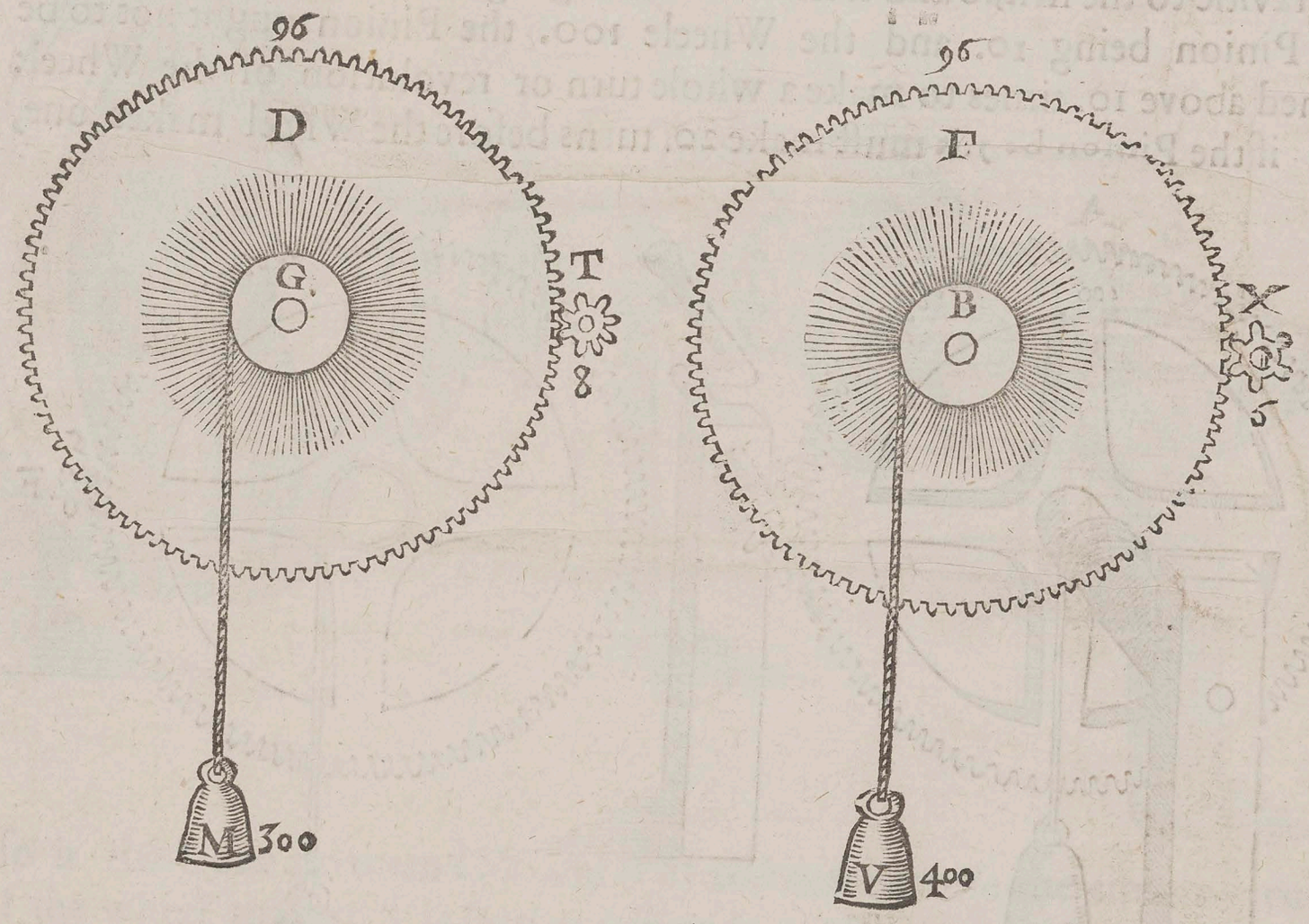
because the number 5. is contained 20 times in 100. And so as the Pinion C is double to the Pinion F, the weight raised by F, shall be double to the weight raised by C, And the time of the raising it shall be also double.

PROP. 15.

If two Wheels are equal in Form and Matter, and there be unequal Weights fastened to their Ax-trees, they cannot be moved by the same Force in the same Time.

THis Proposition doth in some sort result from the former, as may be seen in the Demostration.

Let there be two equal Wheels D and F, of 96. Teeth, and let there be fastened to the Axis G a weight of 300, and to B, one of 400; and let it be supposed that the Pinion T, of eight teeth moves the said weight by the means of the force of one Man. It is certain that if there be put to the Wheel F, a Pinion equal to T, that the same Man or the same Force which was onely made to turn T, will not suffice to turn a Pinion equal to it in the Wheel F, because of the weight V, which is heavier then M: If then you would move the Weight V by the same force; you must put to the Wheel F a Pinion which hath such proportion to T, as the weight M hath to the weight V. Now the Pinion T being of 8. the Pinion X must be of 6. be-



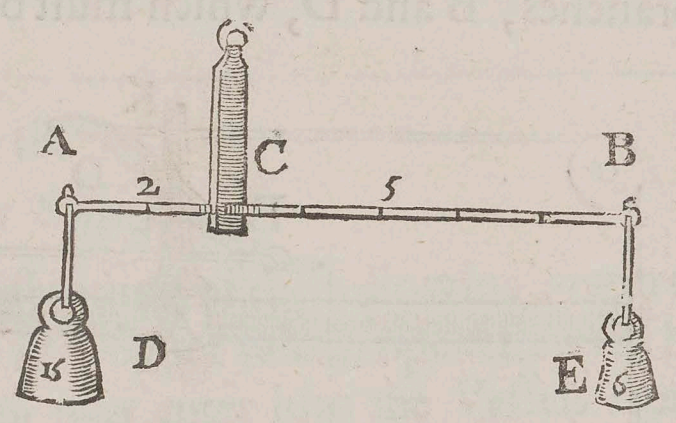
cause that there is the same rate of 8. to 6. as of 400. to 300. and the same Pinion X of 6. teeth being moved by the force aforesaid, the weight V shall be raised; but not in the same Time, because there are made but 12. Turns of T, to make one Turn of D, and there must be 16. Turns of X to make one Turn of F.

PROP.

Prop. 16.

If two unequal Weights be put to the ends of the Beam of a Ballance, and if they be hanged on a point which divides the Beam into two parts having the same rate the one to the other, in length, as the said weights have in heavines, Those weight although unequal shall be in equal ballance, if the lighter be put to the end of the longest part of the Beam.

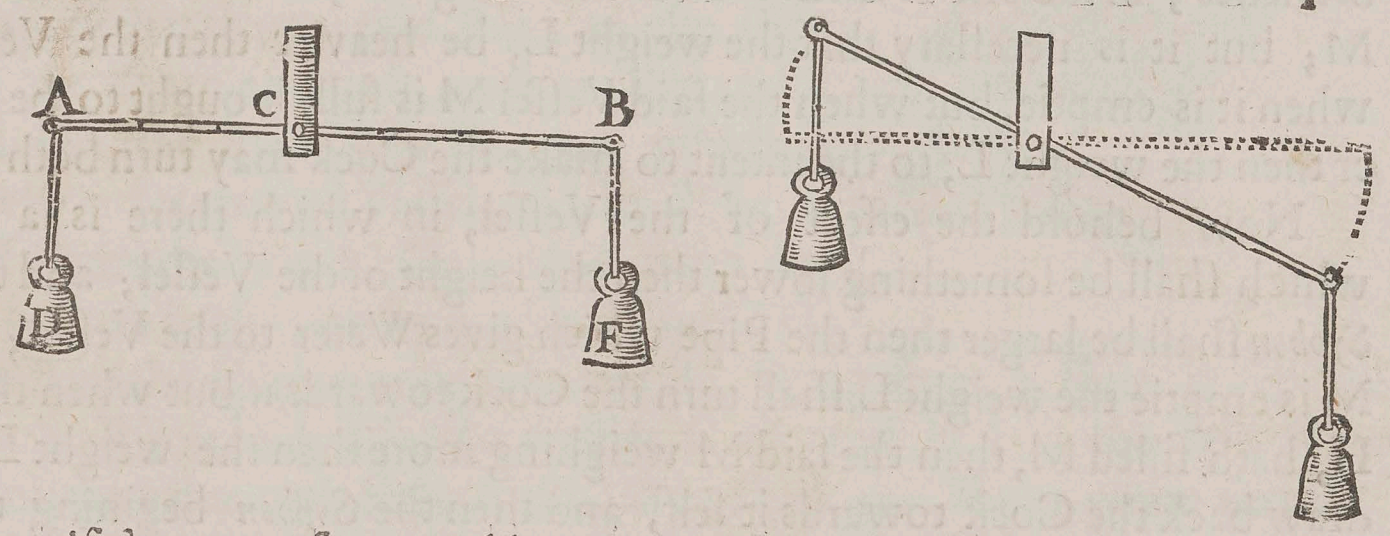
LEt the unequal Weights be D and E, and let D be 15. pound weight and E 6; I say that they being at the end of the Beam of the ballance A B if they be hanged on a point as C, so as the part A C may have such proportion to the part C B, as the weight E to the weight D; D being at the shortest distance from the center of the Beam shall not weigh more then E, which is at the longest end: because the weights are heavie in proportion according to their distance from the point on which the Beam of the ballance is hanged.



Now if the Beam of the ballance be divided into 7 parts there shall be 5 parts on the one side of the Center, and 2. on the other; which are in the same proportion as the Weights 15. and 6; because 6. is the two fifts of 15, as 2. is of 5. And if the difference of the Weights D and E, were greater or lesser, they shall alwaies be in equal Ballance, if the Beam be hanged from a point which divides it as is before said. You may see other Examples in the Figures following P, which differ from this.

A Corollarie.

From hence it follows, that two equal Weights are not alike heavie if they be put at the end of a Beam which is hanged from unequal parts: And it must be observed that although the two sides of the Beam are in equal



ballance, if they are of unequal length, equal weights shall weigh unequal.

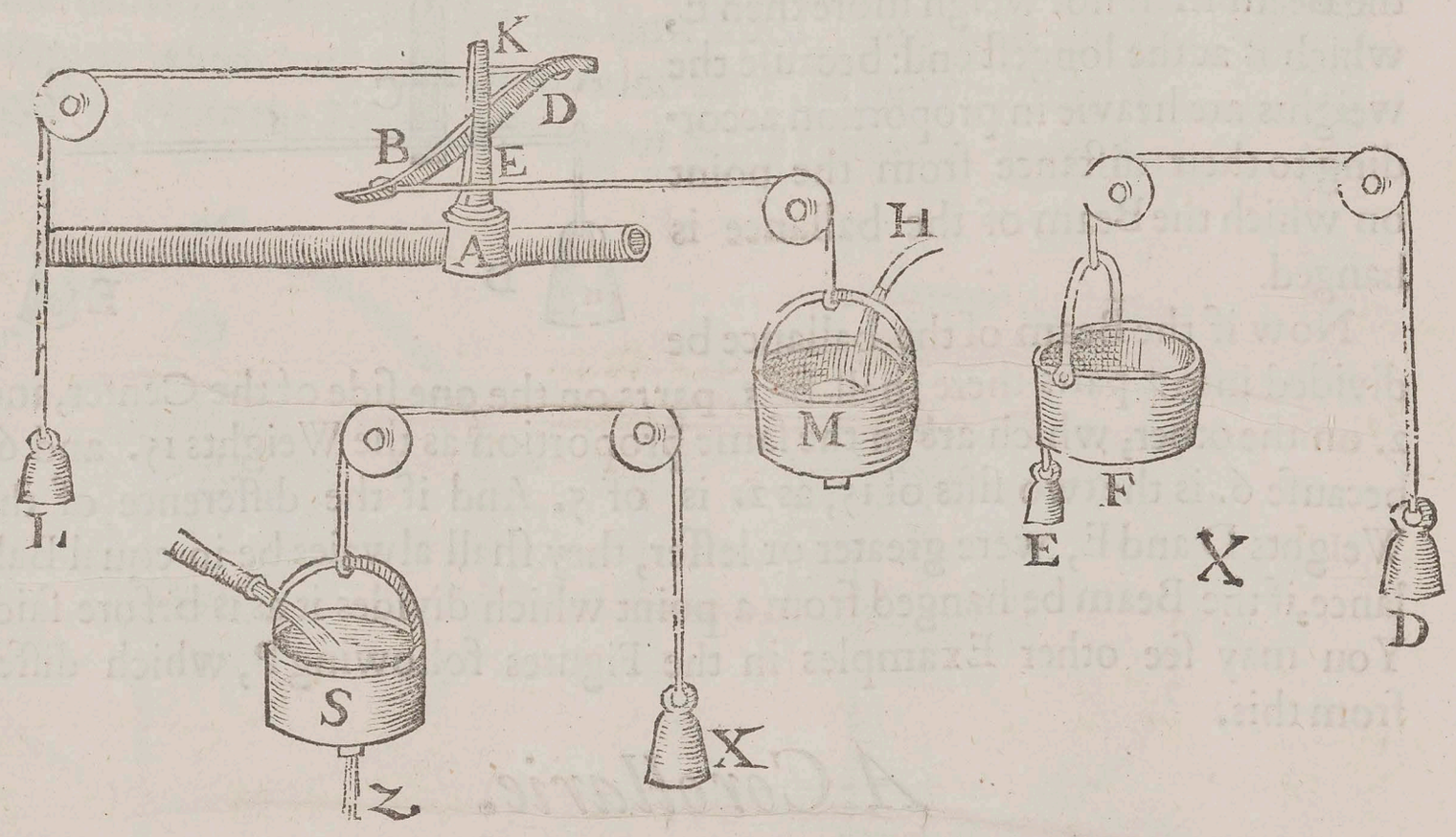
As for example, If the Beam A B be hanged in C, so as C B may be longer then A C by a fourth part, and yet A C and C B be in equal ballance, because the part A C is thicker then the part C B, yet if the equal weights D and F, be put to the ends of the Beam A B, the weight F shall weigh a fourth part more, which is the difference of B C and A C.

PROP. 17.

The manner to shut and open the Cocks of the Phneumatique Engin, by the means of Water.

IN the Construction of the *Phneumatique Engin* which causeth Water to mount higher then the Spring, There is required a Vessell which ascends and descends by means of the Water to turn the Cocks; therefore I have put here certain examples, among which you may chuse the most convenient both for that Engin, and for the other Engins.

As in the first place, Let there be the Cock A, which is to be turned by means of a Vessel: First there must be put the key K E, which hath two branches, B and D, which must be long or short according as the said



Cock is hard or easie to turn; as may be gathered from the 13. Proposition; and there shall be two smal chains or chords at the ends of the two branches; at the one of them shall be the weight L, at the other the Vessel M; but it is necessary that the weight L, be heavier then the Vessel M when it is emptie, but when the said Vessel M is full, it ought to be heavier then the weight L, to the intent to make the Cock may turn both waies.

Now behold the effect of the Vessel, in which there is a *Syphon*, which shall be something lower then the height of the Vessel; and the said *Syphon* shall be larger then the Pipe which gives Water to the Vessel; when M is emptie the weight L shall turn the Cock towards it, but when the Pipe H, hath filled M, then the said M weighing more then the weight L, shall draw back the Cock towards it self, and then the *Syphon* begining to run shall make M lighter then the weight L, and so the Cock shall be turned back again.

There may be also made another Vessel as F, which may be so hanged upon the handle as it may be moveable upon two Pins, and may over-turn and emptie the water when it is full. And to perform this, the Pins must not be diametrically opposite, but more towards one side then towards the other; Now because the said Vessel being emptie should return of it self,

the

the counter-poiſe E muſt be put to the lighter ſide, to ballance it equally; this being done, if there be a weight (as hath been ſaid in the aforegoing Propoſition) which ſhall be heavier then F, that Veſſel F ſhall be at the higheſt when it is empty, but when it is half full being heavier then D, the ſaid Veſſel ſhall deſcend towards F, and being full it ſhall emptie it ſelf towards X: and being emptie it ſhall be again lighter then the Weight, and return to its firſt place; where it ſhall be till it be filled again to deſcend.

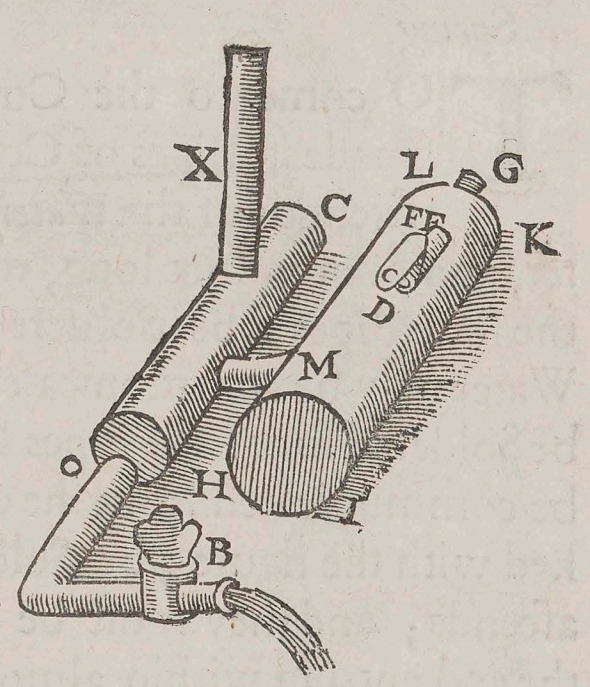
The reaſon of the emptying may be gathered from the *Corolarie* of the 16. Propoſition.

There may be alſo made another manner of Veſſel for the ſame uſe: as you may ſee in the Figure *S Z X*.

Prop. 18.

Of the Value or Suſpiral.

IT will be alſo neceſſarie for the underſtanding of the following Engin to demonſtrate the manner of the value of Copper which openeth it ſelf by intervals; to the intent that if the *Air* may enter into the Veſſels from beneath, and ſhut it ſelf when the ſaid Veſſels are full; to the end that the Water paſs not out by it, The which value ſhall be figured thus, Let H I K L be a ſmal box of Lead, about one inch and a half in diameter, and 3 inches long very wel Soldered, within the ſaid box is the value G D C E made after this manner: G D is a ſmal Pipe of Copper, about $\frac{1}{4}$ of an inch; and towards the end D there are two ſmal props which hang the tongue or value of Copper C, which falls upon the hole D, to ſhut it when there is need, there is alſo to the box H I K L a ſmal Pipe X M, the lower part of which is ſoldered to the Pipe O C.

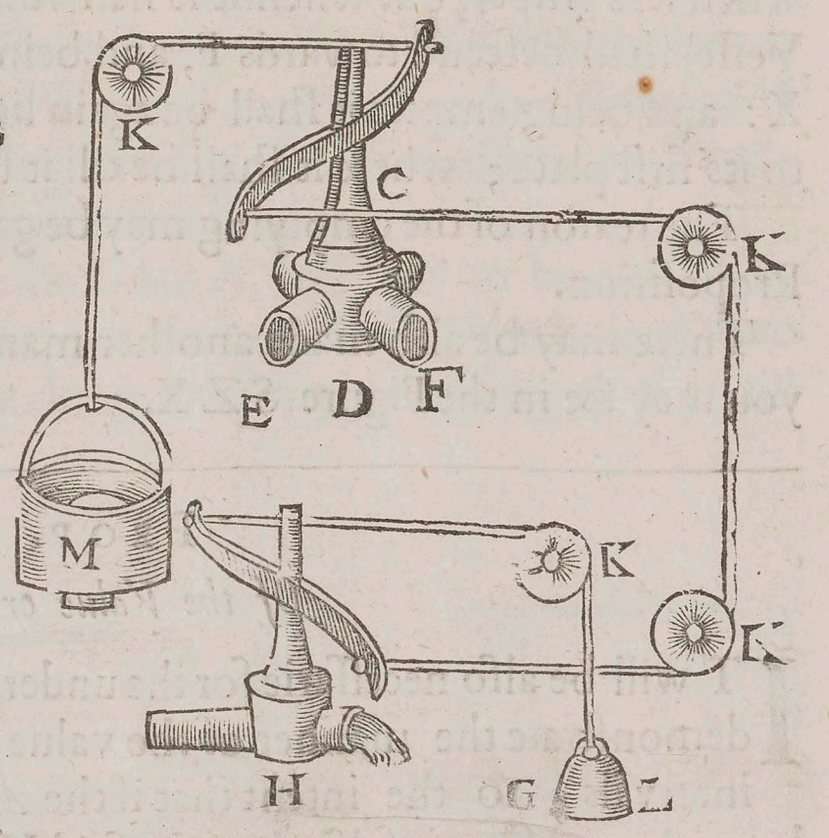


Then to ſee the effect of the ſaid value; Let us ſuppoſe that there is two Pipes to the Pipe C O, the one to emptie it, and the other to fill it: and let the Pipe X be ſtopped, which is that which fils the ſaid Veſſel, and let B be opened; then the Water that comes from the Veſſel draws in the *Air* by the ſmal Pipe D G, and lifts up the Copper tongue C and B: Being ſtopt it ſhuts it ſelf and when the Water hath filled the Veſſels C O, and H I L, the ſaid Water preſſing the value againſt the end C, there ſhall no Water come forth.

PROP. 19.

Of the Cock with four Vents.

THis Figure following is set down to shew more distinctly the manner of the Cock D; whose barrel is pierced in 4 places; to the end that the key C turning either one way or the other, in the required time, the Water may sometimes run out by E, and sometimes by F; and that F or E may run when the hole of the key C shall agree with the one or the other of them: It shall also emptie by means of the Vessel M, as the Cock H shuts, when one of the Pipes is opened, and then when the said Pipe shuts to make the other Run, then the Cock shall open again by means of the counter pois G L, and the Pullies K. As you see it in the figure.

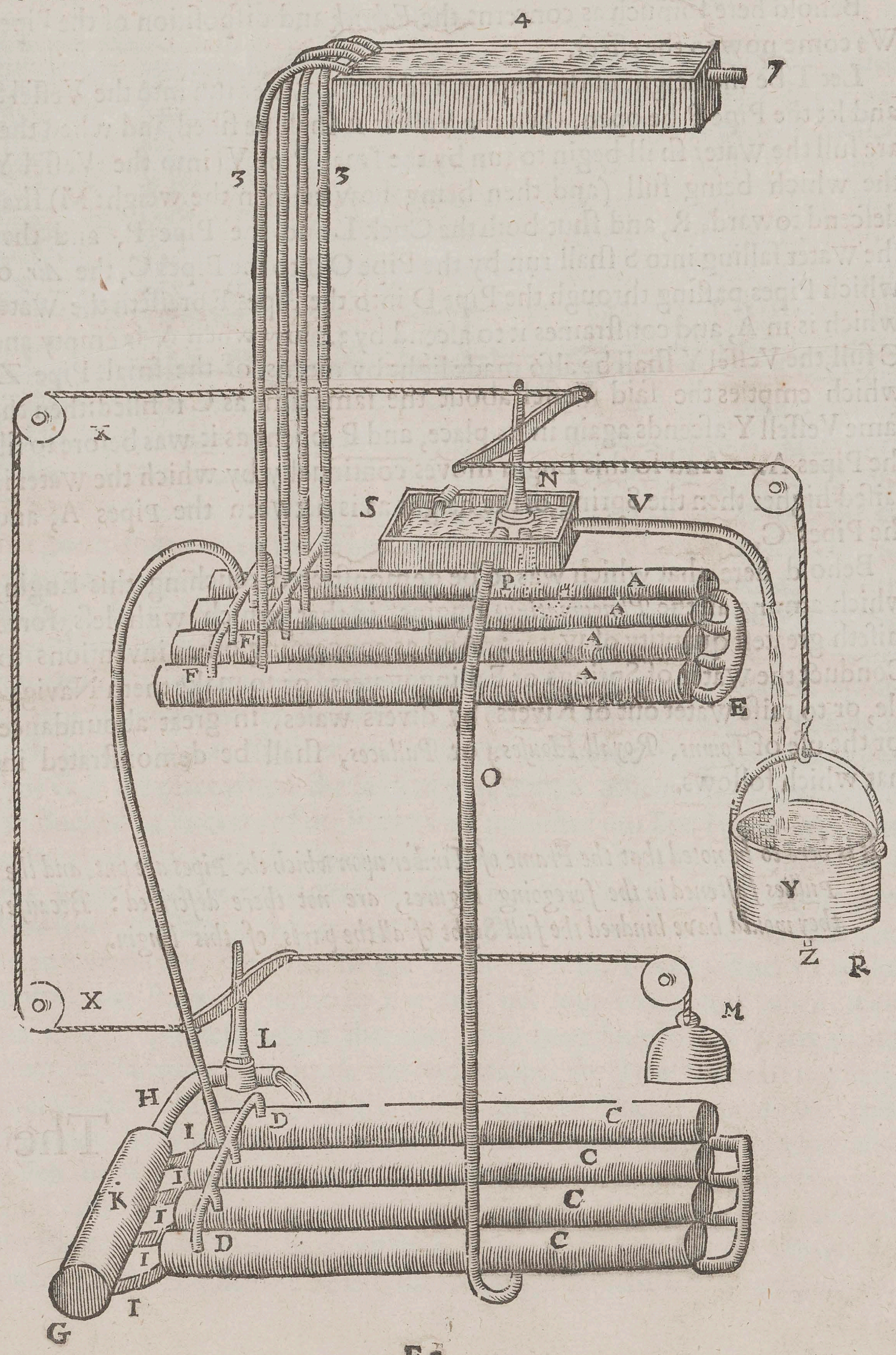


A Description of the Engin *by which part of the Water is raised higher then the Spring.*

TO come to the Coustruction of this Engin. First let there be made 4. Pipes of Copper, or of thick Lead sufficient to bear the strength of the *Water* and *Air*, and let them be 6. inches in Diameter, and 6. or 7. foot long, marked in the Figure with the letter A, and let the little Pipes E be Soldered to the ends of them at the bottom, so as the Water may be communicated from one to the other: furthermore let there be Soldered four smal Pipes F, above the Pipes A, to the intent that the *Air* be communicated from the one to the other: also let four little Pipes marked with the figure 3 be Soldered, which are those by which the Water ascends; and they must be Soldered a travers above the great Pipes, and the end entring within almost to the bottom. Moreover there must be four other great Pipes made like to the first, the which shall be put asmuch lower as you would raise the Water higher then the Spring, and let the smal Pipes D be Soldered in them, to the end that the *Air* may enter there when the Water enters by the Pipes C, and therefore let them be Soldered above; and let there be four Pipes at I communicating all the Water to the Pipe G H, and let the Cock L be Soldered to the bottom of that Pipe and above at the top let the value K be Soldered, made as is before described in the 18th Proposition: and let the Pipes D and F be made common by one Pipe: moreover let the smal Vessel S be made, which may have the sides about the height of one foot; and upon the bottom of it by the base of the *Emboiteure* let there be Soldered the Cock N, to which Cock let there be

the

the Pipes O and P, the which Pipe P ſhall go almoſt to the bottom of one of the Pipes marked with A, and O ſhall be conducted almoſt to the bottom of the Pipes C: alſo at the top of the Veſſel S, let there be the ſmal Pipe V, to give Water to the Veſſel Y, when it is required: which Veſſel Y ſhall be of Copper, having a ſmal hole at the bottom. Concerning the motion whereof, it hath been declared in the foregoing Examples. There muſt be alſo a Counterpoiſe M, to the intent that when the Veſſel Y ſhall be empty it may draw back by its weight as well the Veſſel as the Cocks, in their place



by

by means of the ſmal chains and Pullies X: There ſhall be alſo at the end of the Pipes marked 3, a Veſſel marked 4, to receive the Water which ſhall be there diſcharged by Intervalls from the ſaid Pipes, and to render it by the Pipe 7, which runs continually being of equal thickneſs to two of the ſmal Pipes marked 3, the which ſhall raiſe the Water higher then the Spring; as high as you will, if there be place to put the Pipes C low enough: becauſe that the further the Pipes A and C are the one from the other, the higher the Water will riſe, to the Veſſel 4.

Behold here ſomuch as concerns the *Fabrick* and diſpoſition of the Pipes. We come now to the effect.

Let T be the height of the Spring, and let the Water run into the Veſſel S, and let the Pipe P be open, then the Veſſels A ſhall be filled, and when they are full the Water ſhall begin to run by the ſmal Pipe V into the Veſſel Y, the which being full (and then being heavier then the weight M) ſhall deſcend towards R, and ſhut both the Cock L and the Pipe P, and then the Water falling into S ſhall run by the Pipe O into the Pipes C, the *Air* of which Pipes paſſing through the Pipe D into the Pipes F preſſeth the Water which is in A, and conſtraines it to aſcend by 3. Now when A is empty and C full, the Veſſel Y ſhall be alſo made light by means of the ſmal Pipe Z, which empties the ſaid Veſſel aboūt the ſame time as C is filled: then the ſame Veſſell Y aſcends again in its place, and P opens as it was before to fill the Pipes A. And ſo this Engin moves continually, by which the Water is raiſed higher then the Spring, of the height as is between the Pipes A, and the Pipes C.

Behold here that which was to be demonſtrated touching this Engin, which among all the *Pneumatique* Engins, is that which with leſs force raiſeth greateſt quantity of Water: And as concerning other inventions to Conduct the Water of Springs or Falling Waters, or to make them Navigable, or to raiſe Water out of Rivers by divers waies, in great aboundance for the uſe of *Towns*, *Royall Houſes*, or *Pallaces*, ſhall be demonſtrated in that which follows.

It is here to be noted that the Frame of Timber upon which the Pipes are put, and the Pullies faſtened in the foregoing Figures, are not there deſcribed: Becauſe they would have hindred the full Sight of all the parts of this Engin.

The Explanation of the *PLATES* and *FIGURES* Following.

The first Plate, *Figure* I. *To raise Water by the currant of a River, and the force of a Pump.*

THIS Engin commonly called a Pump, is called by *Vitruvius* and *Hero*, the *Stesibique Engin*, retaining the name of the Inventor thereof; which was *Stesibius* of *Alexandria*. I will shew three waies to raise Water by this Engin. The first shall be by the currant of a River (as the Figure Shews) where there is a water Wheel, and at each end of the Axeltree of the said Wheel is a handle of strong Brass, and forged to sustain the force and weight of the said Wheel: and if the said Wheel be ten feet broad, and twelve feet in Diameter, the said handle shall be at least four inches square, and shalbe rounded in the middle at the places marked with A, and there shalbe also two peeces of wood called Levers marked with the letters B and C, fitted to the arm of the said handles, the one of which riseth, and the other goeth down when the Wheel turns: and the said Levers shalbe also fitted to two arms or branches marked with D and E; the which raiseth the Buckets and Suckers of the Pumps Alternately, and so the Water shall be raised to the Vessel F; And from thence you may conduct it whither you please. As concerning the height which it ought to rise; I am of opinion that it must not be constrained to rise more then thirty feet in height with one Pump; as shall be taught in the following Probleme: the great Pipe G, is the place where the Sucker lyes, which sustains the Water when the Buckets or Suckers of the Pumps are not lifted up. The Figure with the ordinary practice which is had of Pumps, will make you easily understand this Engin. And if the currant of the River be strong, and it is required to have store of Water; you may make the Diameter within the Barrells ten or twelve inches, and the height eight or nine Foot: And to make it well, the Buckets ought to rise and fall four foot; and when they are at their greatest height that they may have four foot of Water above them, to the intent that the *Air* may not escape; for if the Water be not high enough between the top of the Barrel and the Bucket, the *Air* will pass thorough the Water by bubbles, and make the Engin useless: and especially when the Water is forced to rise above fifteen or twenty foot. Therefore you must take heed that that accident do not happen. The proportion also of the Pipes M N O shall be about four inches in Diameter, if the aBrrels be twelve: if the said Barrels be less, the said Pipes shall be less in proportion.

The Explanation of the Second Figure. Plate II. *Another way to raise Water by means of a falling Water.*

THis other manner of raising of Water, is done by a falling Water, raised so as it may fall upon the Wheel A, to turn it; and in turning it to raise the Water of the Pump B, to 24. or 30. feet high, and the other side C takes the said Water in the first elevation in the Trough D, and may raise it from thence 24. or 30. feet high. The aforegoing Figure will give the manner and way of the raising of the Water in the first height: and the second height is done after the same manner, as may easily be comprehended by the Figure: the which Figure is not made high enough according to the proportion of the measures, because the Paper would not permit: but you may easily imagine the said height, as it ought to be.

Explanation of Plate III. *To raise the Water of a Spring, or River by the force of Horses.*

BUt if there is not a River strong enough, nor a falling currant, the Water may be raised by the means and force of one Horse, or more, according to the quantity and the heigth which is desired. This present designe is made to raise the Water 60. foot high, and four Horses will raise about 60. in an hours time, which is about 30000. pound weight. Therefore first let there be a straight Axeltree of wood, a foot square, and 60. foot high, marked with A, the which turns between two Pins, and above near the end, there is a Wheel of 24 Teeth, marked with B, the which turns a Lanthorn or Pinion of 12. Staves, marked with C, and a Wheel of eighteen Teeth, marked D. But there are but nine Teeth in the half of the Circumference, the other half is void; and there are also two other Wheels, marked with E and F, of equal bigness, and also nine Teeth on each Wheel; and let the toothed part of all the three Wheels be put above: then there must be a Pully put above marked with G, over which a Cord must pass, the which must be fastned by the two ends to the Axeltrees of the Wheels C and F, so as turning about one of the Wheels it may unturn the other: as you may see, and better consider in the Figure of the *Orthographie* following. Then you must put the said Wheels E and F, against D, so as D turning alwaies the same way may make E turn half a turn, and then when it shall be in the last Tooth, the first of the Wheel F shall represent it self against the Wheel D, because the Wheel E shall make it turn back again, by means of the common Cord and Pully G: and after the said Wheel D hath catcht the first Tooth of F, it shall continue to the ninth; and afterwards the first of the Wheel E shall represent it self again. And so the two Wheels E and F shall turn forward and backward half a turn alternately: and to the Axeltree H and L there shall be fastned two strong Cords, which shall draw up the two Buckets which go into the Barrels M and N, and have about three feet play, rising and falling; and they shall be made of Brass, well fitted within the Barrels, and that they may descend of themselves without being constrained,

conſtrained: And ſo there is no Leather put about the Buckets, as is ordinarily done in common Pumps. And it is to be noted that the ſwifter the Buckets come up, ſo much the more water they raiſe, which may be obſerved in all ſorts of Pumps.

It is alſo to be noted that the two Tranſverſe peeces O P ought to be but one peece, to the which the other Tranſvers peece Q ought to be joyned, in the which the four ends of the Axeltrees of the Wheels B C E F do turn.

The Explanation of Plate IIII. *This Plate gives a larger demonſtration of the former, by means of the* Orthographie.

FOr the better underſtanding of the foregoing Figure, I have repreſented here the plain of the *Orthographie*; to the end that by it you may underſtand the motion and meetings of the three Wheels E D F. Let then each of thoſe Wheels have nine Teeth in the half Circumference, and let that part of the Wheels that hath the Teeth in them be turned upwards, ſo as the firſt Tooth of the one meet with the Teeth of the Wheel D, when the laſt of the other hath paſſed beyond it: and there muſt be a Cord marked R S to go in a Pully marked T, the which ſhall be firmely faſtned to the two Axtrees, as may be ſeen in the Figure. So as if the Teeth of the Wheel E be entred, it ſhall make the Wheel F to turn half a turn by the Cord which is faſtned to the Axeltree of the ſaid Wheel, and ſhall preſent the firſt Tooth V when the laſt of the Wheel E marked with X ſhall be paſſed: and ſo the Wheel F making its half turn, ſhall make E to return as it was before; ſo as by means of theſe half turns (turning and returning) the Buckets of the Pumps ſhall be raiſed and depreſſed, as if it were with a turning handle: And the difference which is between the ſaid handle and this preſent Invention, is, that the ſaid handle doth not raiſe the Bucket Perpendicularly, as this preſent Invention doth, the which is much better. Likewiſe to raiſe the water very high, and in ſuch aboundance, it is neceſſary that the ſaid handles be very ſtrong, as hath been ſaid before. And if you will not uſe the ſaid handles to the foregoing Engins to raiſe the Water by the means of water Wheels, you may uſe this preſent Invention.

As concerning the Barrels, if you would ſpare the quantity of Braſs or Lead which they ought to have in making of them 30 or 40 foot long, you may make them onely of 4 foot long, of the Diameter of the Bucket, and over them *viz.* at Z Y fit ſmaler Pipes into them: as you may ſee in the Figure.

The Explanation of Plate V. *To make a Dyal with the courſe of a natural Fountain, the which ſhall move very true, without being ſubject to be wond up Dayly.*

LEt the courſe of the Fountain be from the Pipe marked with A, the which ſhall be hollow within about the Diameter of a writing Quil, the Water whereof ſhall fall into the Veſſel B, to which there ſhall be two Pipes, that is one marked with C, Soldered to the bottom of

the ſaid Veſſel, which hath a ſmal Cock marked D; then there is a ſmal emptying Veſſel marked with E, and the ſaid Veſſel ſhall be faſtned to a ſmal Lever marked with F G, made as the Figure demonſtrates, with a hinge to bend only one way: and the end of the ſaid Lever ſhall be entred in one of the Teeth of a great Wheel, marked with H I, ſo as the Veſſel E deſcending the end of the Lever G ſhall raiſe the Tooth in which it is entred, ſomewhat more then one Tooth, to the intent that the greater Leaver L may fall into the next Tooth, and ſtop the Wheel H I: there ſhall be alſo a counter-pois marked O, faſtned to the Lever F G, to draw down the end G, when the Veſſel E is empty, and ſo the Water falling in the ſaid Veſſel ſhall make it heavier then the conuter-pois O, and then it ſhall deſcend and raiſe the end G, and move the ſaid Wheel H one Tooth: and the Water falling alwaies ſhall fill the ſaid Veſſel and make it to overturn, and then the counter-pois O being heavier then the empty Veſſel ſhall again draw down the end G, and the other above marked with L ſhall ſtay the wheel that it ſhall not return: The ſaid Wheel muſt have 60 Teeth; and ſo the Water which falls in the Veſſel E being ſo juſtned by the Cock D, that every minute of an hour the ſaid Veſſel may overturn, and by that means the Wheel H I ſhall make one Turn in an hour: and then you may make a Pignon to the Arbor of the ſaid Wheel having ſix Teeth, the which may move a Wheel of 72 Teeth, and by that means the hand above M ſhall ſhew the courſe of the 12 hours, and that beneath ſhall ſhew the courſe of one hour: and when the ſaid Dyal ſhall be well juſtned, it ſhall continue a long time without alteration. You muſt alſo note that it is neceſſary that the water of the Veſſel B be as high as the Pipe P, to the intent that the ſaid Water fall alwaies equally in the emptying Veſſel; and that it may ſo do, it is neceſſary that there fall ſomewhat more Water into the ſaid Veſſel B, then there runs forth by the Pipe C: and the overplus ſhall run out by the Pipe P.

The Explanation of Plate VI. *To counterfeit the Voice of ſmal Birds by means of* Water *and* Air.

LEt there be two Veſſels marked with A and B, that marked with A ſhall be filled with Water, and that marked with B very cloſe and Soldered on every ſide, then the Pipe C D, muſt be Soldered one end to the bottom of the Veſſel A, and the other paſſing to the upper part of B, and that the end D may be ſo far diſtant from the bottom of B as is neceſſary to let the Water paſs, there muſt be a Cock marked with P, to the ſaid Pipe, to open and ſhut it when it ſhall be required: There muſt be alſo made the Pipe G H, by which the *Air* may paſs through the ſaid Veſſel A, or elſe it ſhall be conducted to the place where you would make the Birds to Sing; to the end of which ſhall be fitted a ſmal Whiſtle like to thoſe which the *Organ makers* do make, to repreſent the Song of a *Nightingale*, and the ſaid Whiſtel ſhall be put into the Water; and ſo when you open the Cock F, the Water ſhall deſcend to the lower Veſſel, and the *Air* which is in the ſaid Veſſel ſhall iſſue forth by the Pipe G H, the which ſhall make the Whiſtel to ſound which is

at

at the end of the ſaid Pipe, and then you may put to it an Artificial Tree, upon which you may put ſome Birds of Wood or Mettal, painted like as the natural.

As concerning the Figure of the Globe D B, it may ſerve for pleaſure to caſt the Water very high by the Pipe A, after that you have forced it in with violence with the Seringe C.

And for the manner of the Whiſtle put into the Water, you may ſee it Figured in the following Figure at the place marked with K,

---

The Explanation of Plate VII. *To add a Swan or other figure to the ſinging of the Birds ſpoken of before, which ſhall Drink or Sip up as much water as you ſhall preſent to her Beack.*

THis is onely the difference between this and the foregoing Figure, that the Veſſel above marked with A is cloſe and Soldered on every ſide: it ſhall have a ſmal receptacle or Funnel N to fill it, the which being full and N ſtopped, when you open the Cock F the Water entring into the lower Veſſel ſhall make the *Air* paſs forth, and ſo make the Birds Sing, and the Water paſſing out of the upper Veſſel A ſhall ſip up by the Beack of the Swan all the Water or liquor which you ſhall put under her Beack.

It hath been ſaid before that K is the Figure of the Whiſtle put into the Water to immitate the Singing of Birds.

The Explanation of Plate VIII. *To make an Engin which ſhall move of it ſelf.*

THere have been divers Men which have Travelled to find out a motion which they have called (without knowledge) Perpetual, or without end, a thing very ill conſidered and ill underſtood, becauſe all that which hath a beginning is ſubject to have an end; and the word Perpetual or without end ought to be applyed to God alone, who as he had no begining, cannot alſo have an end, ſo as it is folly and deceit in Men to make themſelves beleeve that they can make perpetual Works; ſeeing that themſelves are mortal, and ſubject to an end: ſo alſo are all their works: Therefore I will leave thoſe words of Perpetual or without end, and will ſhew the *Fabrick* of an *Engin* which ſhall move of it ſelf, ſeeing it is Intertained of the four *Elements*, of which it is compoſed; and the reaſon of its motion ſhall be Heat or want of Heat, which ſhall ſerve as a Counter-pois to that Engin: as may be ſeen here by the Conſtruction. Let there be a Veſſel of Lead or Copper, aboût a foot and a half ſquare, very cloſe and Soldered on every ſide, which ſhall have a Pipe in the middle, marked with D E, the end E ſhall be neer the bottom of the Veſſel, leaving onely room for the Water to paſs, the other end D ſhall be well Soldered againſt the top of the Veſſel, and it ſhall have alſo a vent marked with F: afterwards you muſt raiſe up the two ſides of the Engin N M, ſo as the Axtree O with the Pully G may turn eaſily, and may ſhew the motion of the ſaid Engin with-

out the ſide M: the motion of which Engin with the Index is oppoſitē to the ſaid Axtree: there muſt be alſo the border P Q Soldered upon the Veſſel, the which ſhall ſerve when you will to put Water into the Veſſel; and alſo when the Water aſcends by the Pipe E D that it might not ſcatter abroad: all this being well and juſtly made, powr Water into the ſaid Veſſel by D E, till it be about the third part full; and while you put the Water in open the vent F, But when the Water is in, ſtopp it very well. Then you muſt have a little bal of Copper very light, marked with the letter L, the which may float upon the Water, and ſhall be faſtned by a ſmal thred, ſo as the ſaid bal may Aſcend and Deſcend by the Pipe D E, when the Water riſeth and falls: alſo the ſaid thred to which the bal is faſtned muſt paſs over the Pully G, to the end of which thred is faſtned a ſmal Counter-pois R, as the whole may be well ſeen in the Figure. Afterwards you may put the ſaid Engin in a Chamber, where the Sun ſhines in at Noon: Then when it is made a little hot the bal is raiſed up, and the Counter-pois depreſt, which will turn the Index, and will ſhew the height that the bal is mounted, and as it is colder the bal Deſcends, and ſo as the Times change ſo the bal riſeth and falls. You muſt note that if the Veſſel be one foot and a half high, and being filled a third part with Water, there ſhall remain one foot for the bal to riſe and fall: and making the Pully four inches in Diameter, then it ſhall turn one Turn if the bal be raiſed up to the end D, ſo that dividing the Dyal into twelve equal parts, each part ſhall ſhew an inch that the bal hath riſen or fallen.

As concerning the uſe of this Engin, it will ſerve to ſhew the temper of the *Air*, and whether the dayes are Hott, or Cold, or Temperate.

The Explanation of Plate IX.

IN this Plate there are two Figures marked with 1 and 2, the firſt marked with 1, is a Clock of an other manner, which may be made in places where there is found no running Spring. Firſt there is made a Veſſel of Copper or Lead, as the Figure A, the which ſhall hold about a Hogſhead of Water: this Veſſel ſhall be ſquare and ſomewhat higher then it is broad, in which there ſhall be a little Veſſel of Copper, marked with F, which ſhall be alſo ſquare, very cloſe, and Soldered on every ſide; the which is to float upon the Water of the ſaid Veſſel A: afterwards there muſt be a *Syphon*, or Crooked Pipe, made as the Figure B C D doth demonſtrate, the which muſt paſs through a Pipe of Copper, which ſhall be in the middle of the little Veſſel: and the ſaid Pipe muſt paſs from one part of the ſaid Veſſel to the other, and the *Syphon* muſt enter into it with ſome force; and the end of the ſaid *Syphon* muſt enter into the Water of the Veſſel A: and above at the point C there is faſtned a Cord paſſing over the Pully L, and at the other end the Counter-pois E ſhall be faſtned, and there ſhall be faſtned an Index to the end of the Axtree I, he which ſhall ſhew the Hours on the Dyal O P: and after the Veſſel A is filled the Veſſel F is put into it, as hath been ſaid, and alſo the *Syphon* and Counter-pois: then you ſhall draw the Water

of

of the ſaid *Syphon* at the end D, with the mouth: and becauſe the ſaid end is lower then the level of the Water of the Veſſel A, the ſaid Water ſhall have its courſe and ſhall fall in an other Veſſel marked with H, and according to the meaſure that the Water of the ſaid Veſſel Deſcends, the ſmal Veſſel F Deſcends with the *Syphon*; which cauſeth the Pully to turn, and conſequently the Hand of the Dyal. To juſten the courſe of the Hours, you muſt lengthen or ſhorten the *Syphon* in the Copper Pipe of the ſmal Veſſel: for putting the ſaid *Syphon* more into the Water it ſhall run Swifter, and on the contrary drawing it back it ſhall make it run ſlower: it muſt alſo be noted, to make it go very true, it is neceſſary to fit a ſmal Pipe to the end D, the end of which, where the ſmal hole is by which the water runs ſhall be of fine Gold; to the intent that the ſaid hole may not wear, which it will do if it be either of Lead or Copper: and when the Veſſel A ſhall be near empty, you ſhall raiſe it again with a ſmal Pump marked with G.

In the ſecond Figure of this Plate marked by the figure 2. *There is declared the manner of a very Subtile* Engin, *to raiſe a ſtanding Water, by means of the* Sun.

THis Engin hath a great effect in Hot Places, as in *Spain*, and *Italie*, becauſe the Sun ſhines in thoſe places almoſt alwales with great Heat; eſpecially in the Summer. The conſtruction whereof is thus. You muſt have four Veſſels of Copper well Soldered round about, each of which ſhall be about a foot ſquare, and eight or nine inches high; the ſaid Veſſels are marked with A B C and D: and there muſt be alſo a Pipe marked with E, put upon the ſaid Veſſels, to which Pipe there ſhall be Soldered four branches, each branch being marked with the letter F, the ſaid branches ſhall be Soldered to the top of the Veſſels paſſing almoſt to the bottom of each Veſſel: Then there muſt be Soldered a Sucker marked with G to the middle of the Pipe, made and placed ſo that when the Water Springs out of the Veſſels it may open, and being gone forth it may ſhut again: You muſt alſo have another Pipe at the bottom of the ſaid Veſſels marked with P, to which there is alſo four branches, the which ſhall be all Soldered againſt the bottoms of the ſaid Veſſels, and alſo a Sucker marked H, to the end of which there is a Pipe which deſcends to the bottom of the Water, the which ſhall be in a Ceſtern or Veſſel marked with I: there ſhall be alſo to one of the Veſſels a hole or vent, marked with M. So placing the Engin in a place where the Sun may ſhine upon it, powr Water into the Veſſels by the hole or vent M, the which Water ſhall be communicated to all the Veſſels by means of the Pipe P: and the ſaid Veſſels muſt have about a third part of their content in Water, and the *Air* which was in the place of the ſaid Veſſels ſhall paſs out by the paſſages 3, 4, 5, 6, afterwards you muſt ſtop all thoſe paſſages very cloſe, ſo as the *Air* may not come out of the ſaid Veſſels; and then the Sun ſhining upon the ſaid Engin ſhall make an expreſſion, becauſe of the heat (as hath been ſhewn in the foregoing Probleme) which cauſeth the Water to riſe from all the Veſſels to the Pipe E, and paſs forth by the Sucker G, and the Pipe N, and

then fall into the Basin O, and from thence into the Cestern I: and when there shall be a great quantity of Water run forth by the violence of the heat of the Sun, then the sucker G shall return; and after the heat of the day is passed, and the Night shall come, the Vessels (to shun vacuity) shall draw the Water of the Cestern by the Pipe and Sucker H P, and shall fill the Vessels as they were before: so as the motion shall continue so long as there is Water in the Cestern, and that the Sun shines upon the Vessels: And you must observe that the two Suckers G and H must be made very light, and likewise very just, so as the Water may not descend by them when it is raised.

The Explanation of Plate X. *An* Engin *by which the force of the foregoing Fountain is increased.*

IF you desire to raise the Water five or six foot high, the foregoing Engin cannot raise it, if the Sun do not shine upon it with great violence: and to increase the force of the Sun, it is necessary that the Vessels of Copper be made in manner as this present Figure doth declare: and upon the side A B there are put Burning Glasses, the which shall be well fitted to the Copper, so as no *Air* may come forth, the said Glasses are marked (the two great ones of every Vessel) by the letters C D, (and the smal ones) E F G H, and the side of the Vessel L must be put towards the *South*, to the end that the Sun shining upon the said Burning Glasses may assemble the raies of the Sun within the said Vessels, the which will cause a great heat to the Water, and by that means make it spring forth in great aboundance, and also higher if it be required: and as to the other sides of the Vessels where the Glasses are, they shall be put towards the *West*, for the Sun shins very hot After-noon: and you must observe that if the great heat makes all the Water to run out which is within the said Vessels, that is to say the third part of their contents, then you may put in more then the third, *viz.* a half of the content by the vent, as hath been said before. I have also made this present Figure greater then that which went before: and as concerning the upper Sucker, it may be in the Vessel which sustains the Basin of the Fountain: And the Burning Glasses may be as large as they are drawn in the Figure A B, and they must be thick in the middle, as the said Figures do declare.

The manner to make a Cement, to Cement the Glasses to the Vessels, so as the Air *may not come forth.*

TO make a Cement to indure the heat of the Sun, and to bind well to the Glass, take five or six peeces of quick Lime, the which being covered with Brick-dust, powr a little Water upon the said Brick-dust, the which shall slake the Lime, and reduce it into powder: and you must be carefull that you wett not the Lime too much: being so brought into powder, then temper it with old Cheese, mixing also about one third part of the said

ſaid Brick-duſt: then Cement well the joynings of the ſaid Glaſſes with the Veſſels of Copper. There is alſo another Sort of Cement to be made, the which is alſo very good for this effect: that is to ſay, of Glaſs ground with Lin-ſeed Oyl, and mixt alſo with a litde Slaked Lime: This laſt is alſo very good againſt the Water, and will not be moiſtned in any manner as the firſt, which ſerves onely for things that are out of the Water.

The Explanation of Plate XI. *An Engin to Saw Wood very readily by the force of a water Wheel.*

THis Engin is very common among the Mountains of the Country of *Switzer Land*, with which they Saw great quantity of Firr Boards: the ſaid Engin is neceſſary to be in a great Citty, or in a Foreſt, where there is great ſtore of Wood to Saw, either in Boards or other form: This here is not altogether like thoſe uſed by the *Switzers*, for they make the peeces of Timber to come to the Saws by means of certain Toothed Wheels with a rochet; but becauſe of the oft reparations of the ſaid Toothed Wheels, I think alwaies to avoid their uſe as much as I can. So I have put the two Counter-pois each about two or three hundred pound weight, the one whereof is marked with A, and the other with B: the Cords on which the Counter-poiſes hang are faſtned to two moveable peeces of wood which ſlide upon two other fixed peeces of wood, by means of certain ſmal Pullies that may be within a hindge, and ſo the ſaid Counter-pois alwaies drawing the ſaid moveable peeces of wood: and the peece which is to be Sawed being faſtned between the ſaid movable peeces, which ſhall come alwaies forward and the Saws riſing and falling ſhall Saw the ſaid peece with great ſpeed: you may put two three or four Saws at the leaſt upon the ſame fram, ſo far aſunder as the thickneſs of the Boards which are to be Sawn ſhall require. And when the peece of Timber is Sawn, then one or two Men with a Lever ſhall turn a Rowler to which a ſtrong Cord is made faſt, which ſhall draw back the ſaid peece, and draw up the Counter-pois, and then you may put the peece a little toward one ſide, ſo as the Saws may take the ſaid peece again.

The Explanation of Plate XII. *An Engin of great ſervice to Bore Elms or other Trees to make Pipes to conveigh Water, and for other uſes.*

LEt there be a water Wheel to the Axtree, whereof let there be faſtned a Wheel of thirty ſix Teeth or more, according to the ſwiftneſs of the Water Wheel, for if it turn ſlow there muſt be the more Teeth, and there muſt be a Pinion of ſix, which is turned by the aforeſaid Toothed Wheel, as may be ſeen in the Figure: and to the Axtree of the ſaid Pinion there ſhall be joyned a long Auger, marked with the letter A, which ſhall be put through a hole marked with B, to be opened and ſhut as occaſion ſhall require, as in a Turners Lathe: then the Tree to be bored is to be placed faſt upon a fram, marked with C D, ſo as the ſaid fram may ſlide eaſily by

the means of certain little Wheels which are in the holow thereof, and turn upon ſtrong pins, ſo as one Man may put forward or draw back the ſaid Tree when it ſhall be faſtned upon the ſaid fram; and ſo the Auger turning, the Man ſhall put the end of the ſaid Tree againſt it, and when it hath entred it two or three inches, he muſt draw back the ſaid Tree, to draw out the chipps of the Auger, otherwiſe it will be in danger of breaking: and ſo you muſt continue alwaies to draw back the ſaid Tree at the piercing of every three or four inches, to take away the Chips, till the hole be quite through: And afterwards if you would have the hole wider, you muſt take ſuch an Auger as the Figure E repreſents, which ſhall widen the hole which was before made.

The Explanation of Plate XIII. *A rare and neceſſary Engin, by which you may give great reliefe to Houſes that are on Fire.*

THis Engin is much practiſed in *Germany*, and it hath been ſeen what great and ready help it may bring: for although the fire be 40. foot high, the ſaid Engin ſhall there caſt its Water by help of four or five Men, lifting up and putting down a long handle in form of a Lever, where the handle of the Pump is faſtned. the ſaid Pump is eaſily underſtood. There are two Suckers within it, one below to open when the handle is lifted up, and to ſhut when it is put down, and an other to open to let out the Water: and at the end of the ſaid Engin there is a Man which holds the Copper Pipe A, turning it to and again to the Place where the fire ſhall be.

The Explanation of Plate XIIII. *To repreſent divers Birds which ſhall Sing diverſly when an Owl turns towards them: and when the ſaid Owl turns back again, they ſhall ceaſe their Singing.*

THis motion hath formerly been repreſented by *Hero* of *Alexandria*, but not with ſo great variety of Birds, as I will here repreſent it. Therefore let there be a water Wheel, as A, the which ſhall turn in a Caſe of Lead or Copper marked with C, the which caſe ſhall ſerve to keep the Water from ſcataring abroad and ſpoyling the motion, and the Axtree of the ſaid Wheel ſhall reſt upon two round holes, which ſhall be on the ſides of the ſaid Caſe, and at one end of the ſaid Axtree which cometh through the ſame Caſe there ſhall be a Pinion of 8 Teeth, marked with D, which ſhall turn a Barrel of 12. or 15. inches; alſo there muſt be 3 conveiances for the wind, marked with E F G, to which there are Soldered 3 Cocks, whereof the Keys are made as M O, to the end that when the Barrel turns the pins Q and R they may make the ſaid conveiances open to let the *Air* into divers Whiſtels, the which ſhall make ſeveral different Tunes, according to the *Fabrick* of thoſe Whiſtles, and the diſpoſition of the Pins and Touches Q and R. And moreover you may give a certain motion to the Tayls and Beacks of the Birds; if you put certain ſtrings to the Keys of the Cocks: as the Figure declares.

As

As concerning the motion of the Owl, which turns forward and backward in a certain ſpace of Time, the motion of it may be ſeen by the turning Veſſel X, and the ſmal Lever 3, and 4. where there is the Counter-pois 8, for this Veſſel deſcends when it is full, and makes the Counter-pois to riſe, and the pin of the Lever ſtops the Barrel by means of the pin marked 6, which is at the end thereof; and ſo the Birds ceaſe their Singing: then when the Owl ſhall be towards them, and when the Veſſel X is void, ſhee ſhall turn again by the means of the Counter-pois, and the Barrel ſhall begin to turn: As the Figure will demonſtrate to you very exactly.

The Explanation of Plate XV. *An Engin by which* Galata *ſhall be preſented, which ſhall be drawn upon the Water by two* Dolphins, *going in a right line and returning of her ſelf, while a* Cyclope *plaies upon a* Flajolet.

LEt there be a water Wheel marked with L, the breadth whereof is ſeparated in the middle, and that on one ſide the Boxes where the Water fals be made to turn toward the right hand, and on the other ſide they be made to turn toward the left hand: and to the Axtree of the ſaid Wheel there is a Pinion which turns a toothed Wheel marked with Z, and the ſaid Wheel hath an Axtree alſo divided into two parts, marked with I and H, and to the ſaid Axtree are two Chains faſtned, ſo that when the ſaid Axtree turns, one of the ſaid Chains may turn about it, and the other unturn; the which Chains paſs about the Pullies G F, and are both faſtned to the Pully B, but one ſhall paſs by E, ſo as when one turns the Axtree I H by the means of the water Wheel, the one of the ſaid Chains may draw the ſaid Pully B towards the motion: but if the water Wheel be made to turn the other way, then the Chain which paſſeth through the Pully E ſhall draw the Pully B to it ſelf, and the other Chain ſhall let it go in proportion: and as concerning the ſaid Pully B, it ſhall be put upon a Pipe of Copper, ſo as there may be a Plate of Copper under the ſaid Pully, between the two long ſtones C and D, ſo as the ſaid Pully may ſlide eaſily upon the ſaid Stones. Then there ſhall be a ſmal Box of Lead or Copper marked with P, about a foot and a half long and broad, to which there is a Valve Soldered to the bottom, marked with R, and at the end of the baſe thereof a Pipe marked with N, and at the middle of the ſaid Box, on the ſide there is a Pipe marked with O, and between the ſpace of the ſaid Pipe and the bottom of the ſaid Box there is a ſmal Pipe which ſhall let Water into the Baſin marked with S, Which ſhall be faſtned to two turning Buckets marked V T, ſo as when the Veſſels ſhall be ful of Water, that it may be heavier then the cover of the Valve R, and on the contrary, when the ſaid Veſſel ſhall be void, the cover of the ſaid Valve muſt be heavier, to the intent that it may ſhut and draw the ſaid Veſſel up, and ſo when the Water ſhall run into the ſaid box by the Pipe V it ſhall riſe up to the Pipe O, and fall upon the ſide of the water Wheel L, then the ſaid Wheel turning, ſhall turn I, and conſequently the Axtree I H, ſo as the Chain ſhall turn about I and unturn H, then the Figure of *Galatea* ſhall move towards the Pully E, becauſe it is drawn thi-

ther by the ſaid Chain which turns about the Axtree I, the ſmal Veſſel S muſt be ſo proportioned, that being fed by the ſmal Pipe, it may be full or near full and draw up the Valve when the Figure of *Galatea* ſhall be near the Pully E, and then the Water which ſhall be in the ſaid box, ſhall fall by the Valve upon the other ſide of the water Wheel, and make it turn the other way, ſo as the Chain H muſt turn about the Axtree on the ſide H, and unturn on the ſide I, which will be the cauſe to make the Figure turn toward the motion, and ſo the Pully B ſhall be drawn (upon which the Figure is placed) ſometimes forward, and ſometimes backward, according as the double water Wheel ſhall turn, ſometimes by the Water that runs by the Valve R, and ſometimes by that which runs by the Pipe O, which is done divers times by means of the ſmal Veſſel S and the turning Buckets T and V, for when the Veſſel S is empty the Valve R is ſhut, and the Water riſeth up to the Pipe O to make the water Wheel turn one way, and when S is full it opens the Valve, and then all the water fals by the Valve R on the other ſide of the water Wheel, which makes it turn the other way: and ſo ſucceſſively.

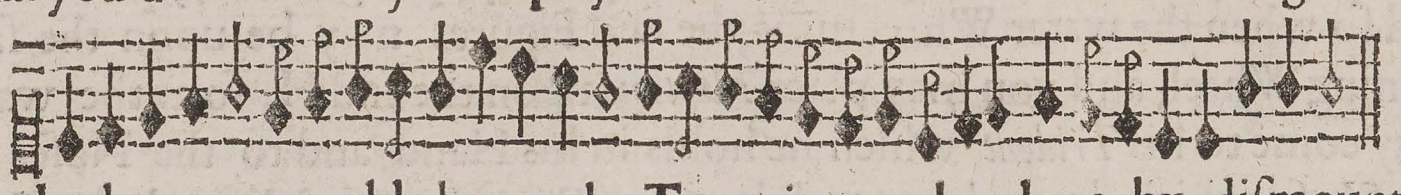
As concerning the *Cyclope* playing upon the *Flajolet*, the motion ſhall be ſhewed in the following Figure.

It is to be noted that the little box marked with P, is here repreſented open on one ſide, to the intent to ſhew the Valve R.

The Explanation of Plate XVI. *An Engin by which the Sound of the* Flajolet *ſhall be repreſented by the courſe of the Water.*

HEre ſhall be repreſented the Engin proper to make the *Flajolet* Sound to the *Cyclope* of the precedent plate: Therefore let there be a Muſical Wheel marked with A, about 4 or 5 foot in Diameter, perfect round, and divided with Teeth, as you may ſee in the Figure, ſo as a Pinion of 8 Teeth marked with B may turn the ſaid Wheel; and to the Arber of the ſaid Pinion there ſhall be a Wheel having 32 Teeth, marked with D, which another Pinion marked with C ſhall turn, and to the Arber of the ſaid Pinion C there ſhall be a water Wheel marked with F, about 2 foot and a half or 3, foot in Diameter, which ſhall be turned by the Water deſcending from the Pipe G, and ſo when the ſaid water Wheel ſhall turn it ſhall cauſe the Muſical Wheel to turn, by means of the other Wheels: afterwards there ſhall be put the Summer marked with H, the *Fabrick* whereof ſhall be ſhewn at large, ſo as the Keys of the ſaid Summer ſhall be Parallel at half an inch diſtance from the Muſical Wheel: afterwards divide the ſaid Muſical Wheel in 25, or 30. equal parts, each part in turning ſhall be an ordinary meaſure of Muſick: and more-over all the ſaid parts ſhall be divided into 8 equal parts, to put on Crochets upon each diviſion, if it be required, of which there are 8 for one meaſure; and if you will you may put on Demi-Crochets, or Quavers: afterwards the pins are to be put upon the ſaid Wheel $\frac{3}{4}$ of an inch above the Superficies of the ſaid Muſical Wheel, ſo as when the Wheel ſhall turn, the ſaid pins may touch the Keys of the Summer

mer and put them down and cauſe them to open the Valvs of the ſaid Summer: as concerning the Pins they ſhall be put according to the Tune that you deſire the *Flajolet* to play. That which is here ſet down begins thus,



And when you would change the Tune, it may be done by diſmounting the Pinion B, out of the Muſical Wheel by means of the Reſt of Iron, upon which the Pinion ſhall be put, and looſning a ſmal Screw which holds the ſaid Reſt in its place, then the ſaid Reſt being drawn from its hole, the ſaid Pinion ſhall be disjoyned from the Muſical Wheel, which may be turned with the hand: you may fit any other Tune upon the ſaid Wheel: the 12 holes that are in the Summer ſerves to conveigh the wind of the ſaid Summer by the conveiances of Copper or Lead, to the *Organ Pipes*, to repreſent the Sound of the *Flajolet*; all which ſhall be joyned to the Figure of the *Cyclope*. The conſtruction of the ſaid Pipes ſhall be taught hereafter: the hooks which hang at the Cords P O, ſerve to draw up the Muſical Wheel, that if there be any fault in the Valves within the Summer it may be helped by opening the ſaid Summer before, as is done ordinarily, the great conveiance marked with S may be of Wood 4 inches ſquare, to conduct the Wind to the Summer, which ſhall come from the Bellows, as ſhall be taught

---

The Explanation of Plate XVII.

IN this Plate is repreſented the Figure of *Neptune*, which ſhall turn Circularly with certain Trytons, and other Figures, which ſhall caſt forth Water in turning. The Wheel work belonging to the motion of theſe Figures ſhall be declared in the following Plate.

The Explanation of Plate XVIII. *This Plate declares the motion, and Wheel-work of* Neptune, *and other figures repreſented in the foregoing Plate.*

LEt there be a water Wheel marked with A, which turning, ſhall turn a Toothed Wheel marked with B, the Pivot whereof ſhall reſt upon a ſtraight peece of wood, and the Arber above marked with P Q, ſhall be faſtned firmly to a Pipe of Copper marked with S R, and at the end thereof there ſhall be a ſmal Receiver, where the water ſhall fall: Then there ſhall be a great Pipe marked with T V, which ſhall be alſo faſtned to the Arber, a little lower then R, ſo as the ſaid Pipe may turn upon another marked with pointed lines which ſhall be interlaced (marked alſo with pointed lines,) and the ſaid great Pipe, and that in the middle ſhall be Soldered firmly to the bottom of the Reſerve of Lead maked with C D, and the great Pipe X V ſhall be Soldered to a great Wheel marked with E F, which ſhall be within two inches of the bottom of the ſaid Reſerve, ſo as when the Wheel below B turns, the ſaid Wheel E F may alſo turn; becauſe they are

faſtned in one common Axtree: then on the top of the great Pipe there ſhall be another ſmal Pipe marked with G H, which ſhall be Soldered againſt R, ſo as the Water Deſcending by the ſaid Pipe may ſpring forth by the end H, and ſo when the water Wheel turns, the ſaid Figures may be upon the ſaid turning Wheel; and you may place *Neptune* upon the end H, ſo as the water may come to his *Trident* which he holds in his Hand, and to the Noſes of the *Horſes* which draws him, and the two *Tritons* upon M, and the *Cupid* which leads the *Dolphins* upon N: And you may likewiſe put certain other Figures upon Z; and to the intent to cover the Pipe which deſcends from S to the Baſe of the Reſerve, you may make a Rock, as you may ſee in the foregoing deſigne, which may deſcend from the top of the Grote where the ſaid motion ſhall be, almoſt to the bottom of the Reſerve, without touching it, nor alſo any of the Pipes, to the end that all may turn freely, and the Reſerve muſt be alwaies full of Water a foot high, to the intent that you may not ſee the motion of the Wheel E F in turning.

The Explanation of Plate XIX. *An Engin by which you may make a paire of* Organs *to Sound by the means of Water.*

THis Engin is very like to that demonſtrated in the 16 Plate, the difference is that, this here is ſeen fore-right, and that other upon one ſide: the Muſical Wheel marked with A may be of five or ſix foot in Diameter, which ſhall be turned by a Pinion of eight Teeth, to the Axtree whereof ſhall be fitted a Wheel of twenty four Teeth, Which ſhall be turned by a Pinion on whoſe Axtree the water Wheel C is faſtned: the Keys are marked with D, and the Summer with F: the conſtruction whereof ſhall be taught afterwards: the three Regiſters marked G H I, are different the one from the other. And to the intent that the noiſe of the motion may not be heard when the *Organs* play, it is good that there be a Wall of a foot thick between the Regiſters and the ſaid motion, the conveighances of the wind are of Copper, which coming from the Summer to the Regiſters paſs through the ſaid Wall.

As concerning the Bellows to give wind to the Pipes; the motion of them ſhall be ſhewn in the next Probleme, and alſo how to put the Muſick upon the Muſical Wheel.

The Explanation of Plate XX. *An* Engin *by which the* Bellows *of the foregoing* Engin *may be lifted up to give Wind to the Pipes of the* Organs.

THere are two manners to give Wind to the Pipes of the *Organs* in *Hydrautique Inſtruments*, the one is with *Bellows* made with thin Boards joyned together with Leather, the other is with the *Air* which comes from *Ciſterns* by want of Vacuity, as ſhall be taught hereafter. At the preſent I will ſhew how to raiſe the ſaid *Bellows* by means of a water Wheel, as you may ſee by this preſent deſigne, where the long branch of Iron or Copper

divided

divided into four turning handles, make the ſaid *Bellows* to riſe the one after the other, by means of the ſaid water Wheel.

The Explanation of Plate XXI. *The repreſentation of the Muſical Wheel, to ſerve for Plate* 19.

TO demonſtrate Intirely the Engin of Plate 19. I will put here the repreſentation of one part of the Muſical Wheel as big as the natural, to the intent that you may perfectly ſee how the Pins put down the Keys of the *Organ*: the ſaid part doth onely repreſent ſix meaſures, the one of which ſhall be marked with Black or Gray all along the ſaid Wheel, and the other ſhall be marked with White, to the intent that the diviſions may more eaſily be diſcerned, which ſhall be Parallel to the Keys: and if you will you may pierce the holes upon each diviſion to change the Pins, when you would change the tune: Then you ſhall put the ſaid Pins ſo as they may touch upon the Keys about the thickneſs of one of the ſaid Pins, and ſo as the one touch not harder then the other. Alwaies when you come to Demi-Crochets or Quavers, whereof there are ſixteen in one meaſure, it will be good that they do not touch ſo hard as the others, to the end that one Pin do not touch before the other have paſſed beyond the Key, which is to be obſerved in all the other meaſures, otherwiſe there will be a confuſed Muſick.

As concerning the conſtruction of the Muſical Wheel, it is neceſſary that it be of Oak, very dry, and the peeces well Joyned and Glued together, to the intent that it do not ſwel neither on the one ſide nor on the other: As for the Pins they ſhall be of Braſs or of hard Wood. Further-more you ſhall obſerve that in this preſent Figure, there is but half the Keys deſigned: alſo many of the notes are wanting to the ſaid Figure, becauſe the Paper was not large enough to draw it ſo large as the Natural: but that which is here deſigned may ſerve to give underſtanding to the reſt.

The Explanation of Plate XXII. *To make* Organs, *or* Trumpets *of* Organs, *to Sound alwaies when the* Sun *ſhall be* South, *without any other principle of motion, but the heat of the* Sun *and the* Water.

LEt there be a Veſſel of Copper or Lead marked with A, very cloſe and Soldered on every ſide, and let it have a Syphon marked with C, which may be ſo made that the end which is within the Veſſel be near to the bottom, and that the height of the ſaid Pipe or Syphon be near the height of the ſaid Veſſel, then the other end ſhall come forth of the Veſſel to run into the Veſſel D.

And to order it ſo as the Sun may not heat the Veſſel A till Noon, Behold how you are to proceede: Let there be a Tablet made to the ſaid Veſſel of ſtrong Lead or Copper, marked with B, (as if it were the Cover of the ſaid Veſſel half lifted up) well Soldered to the ſaid Veſſel, and let the ſaid Veſſel be Invironned with a ſmal Wall of Brick, ſo as there may be

onely the ſide before open to the Sun, and that the ſaid ſide be exactly placed toward the South. It is certain that this being well done, that the Sun ſhall not ſhine againſt the ſaid Veſſel, but juſt at Noon; and then the rays ſhine againſt the angle which the top of the Veſſel makes with the Table B, and by that means heats the top of the ſaid Veſſel, which ſhall make a compreſſion in the Veſſel, ſo as the water ſhall run forth by the Pipe C. Let there alſo be made a great Veſſel marked with F, into which the water of the Spring which is to make the motion runs continually, and at the bottom of the ſaid Veſſel there is a Valve marked with G, at the lower end whereof there is a Pipe with a Cock marked with H, which ſerves to temper the courſe of the Water, which ſhall fall upon the water Wheel which is below.

So when the Sun ſhall be directly *South* (as hath bin before ſaid) his rayes ſhall ſhine againſt the Veſſel A, which ſhall cauſe a compreſſion of the water which is within, which ſhall run forth by the Pipe C into the Veſſel D, which being half full ſhall deſcend and open the Valve G, which being open the water of the Veſſel F ſhall run upon the water Wheel and make the Muſical Barrel to turn, as hath bin ſhewn before; and the Pins that are put upon the ſaid Barrel, ſhall touch the Keys M, which being put down ſhall open the Valves which are under the Summer X, and the wind that ſhall be in the ſaid Summer, ſhall make the Pipes of the *Organs* or *Trumpets* Sound which are above the Summer. Now Wind may be given to the ſaid Summer after two ſeveral manners, that is to ſay, by a Reſerve, which is filled with the water which falls upon the water Weel, or by Bellows which are raiſed by another water Wheel, which ſhall move when the Veſſel D deſcends, and ſhall open alſo a Valve, as that is marked with G: but becauſe the Inſtrument muſt ſtop juſt at the point where it began, (when the Muſical Barrel hath made one turn) to the end that when it begins to Sound another time, the Muſick may be of a juſt meaſure.

Behold how it is made to ſtop. You ſhall make a ſmal Veſſel of Copper marked with E, which ſhall have a ſmal hole in the bottom, and ſhall be ſo placed that the Cord which holds it ſhall be faſtned to a ring near the Valve G, and the water which ſhall fill the ſaid Veſſel ſhall be conveighed by the Pipe marked with L, ſo as when the Valve G is opened forth-with the water ſhall run into the ſaid Veſſel, and when the water of the Veſſel F, ſhall be a little abated, then it ſhall run no more into the Veſſel E, which ſhall alwaies empty the water which is in it by the ſmal Hole at the bottom. And the time that the ſaid Veſſel E empties muſt be fitted to the time that the Wheel requires to make one turn, and the ſaid Veſſel being empty the Valve G ſhall fall down again, becauſe it ought to be made in a manner heavier then the two Veſſels E and D, when they are empty: and on the contrary, when one of the ſaid Veſſels is full, that they may be Heavier then the ſaid Valve: And as concerning the Veſſel D it is neceſſary that it empty rather then E, becauſe it need not keep ſo exact a meaſure as E. And ſee here how it empties, when it is half full with the Water which deſcends by the Pipe C, then it draws down it ſelf, and that marked with E, alſo becauſe it it Heavier then G, and at the ſame inſtant G opens, and the water deſcends upon the Wheel and into the two Veſſels, and when D is full

then

then the Veſſel turns the top downwards and empties, and in the ſame time the water of the Veſſel F abates and is lower then the height of the Pipe D, the water ſhall run in no more, but the end of the Pipe L muſt be ſomewhat lower then that of D, to the end that the water may there run longer. It remains to ſhew how the Pipe A is filled again with water:

Therefore let there be put a Pipe with a ſmal Valve under the ſaid Veſſel, after the ſame manner as in the foregoing Figure, and after that the Heat of the Sun hath made the compreſſion, and that one part of the water of the ſaid Veſſel ſhall be run out after the Sun hath paſſed the ſaid Veſſel, to ſhun Vacuity it ſhall fill again by the ſaid Valve as hath been taught in the 14th Probleme.

In Sum, if all the parts of this motion be well ordered, you ſhall have the deſired Effect with admiration to the Hearers.

The Explanation of Plate XXIII. *To make an admirable* Engin, *the which being placed at the foot of a Statue, ſhall ſend forth a Sound when the Sun ſhineth upon it, ſo as it ſhall ſeem that the Statue makes the ſaid Sound.*

Cornelius Tacitus in his Hiſtory maketh mention that there was in *Egypt* a Statue of *Memnon*, which did ſend forth a certain Sound, when the Sun ſhined upon it. *Pauſanias* is ſaid to have ſeen the ſaid Figure, and that the Sound was like to the Sound of the ſtrings of an *Harp* when they break.

The Demonſtration of this preſent Figure doth ariſe from that which hath been ſhewn before in the 9th and 10th Plate, which teacheth to raiſe the water in a Veſſel of Copper or Lead (with the Heat of the Sun) by means of a Valve A. Now when the water ſhall be in F, it ſhall be tranſported into C by the Syphon B, which caſting its water into C ſhall make the *Air* breath forth of it, and animate the two *Organ Pipes*, which with the Engin may be put in the Figure or in the Pedeſtal, or otherwiſe, if the Engin be put at a diſtance you muſt uſe conveighances for the wind, and ſo the Pipes onely may be in the Figure, which being of Braſs and holow ſhall have no *Air* but by the mouth by which the Sound of the *Organ Pipes* ſhall come forth.

The Explanation of Plate XXIIII. *In this Plate is Figured the inſide of the* Muſical Summer, *for the* Organs *or* Hydrautique Engins, *which we have ſpoken of before.*

THe Summer which is ſpoken of in the 16th and 19th Plate is here (for more eaſier underſtanding) repreſented three ſeveral waies, that is to ſay, By the *Plane* or *Ignography*, by the *Orthography* or *Profile*, and by the *Senography* or *Perſpective*: the *Valves* are marked with M, the *Groves* by E, the *Springs* by H, and the *Keys* by L.

As concerning the Covering of the Summer and Valves, and the matter of the Summer which ought to be of Oak, well dryed, we might ſay divers things, and extend it more at large, but I think that it is not here needfull, I will

will onely add that which the excellent *Poet Dubartas* ſaith upon this ſubject in the following Verſes.

Dubartas
fol 181.

Where, as (by Art) one ſelfly Blaſt breath'd out
From panting Bellows *paſſeth all about*
Wind Inſtrument, enters by th' under Clavers
Which with the Keys *the* Organ Maſter *quavers,*
Fils all the Bulk, *and ſeverally the ſame,*
Mounts every Pipe of the Melodious Frame
At once reviving lofty Cymbals Voice
Flutes ſweeteſt Air, *and* Regals *ſhrilleſt noiſe.*

But concerning the *Syſtemes* and Meaſures of the *Organ Pipes*, both in Length and Breadth, Covered or Open, and alſo of the manner of the Regiſters, great conveiance of the Wind, and the Trembling ſtop, &c. Is refered to a particular Treatiſe of the Conſtruction of *Organs*.

The Explanation of Plate XXV. *A Sluce to render falling Waters* Navigable.

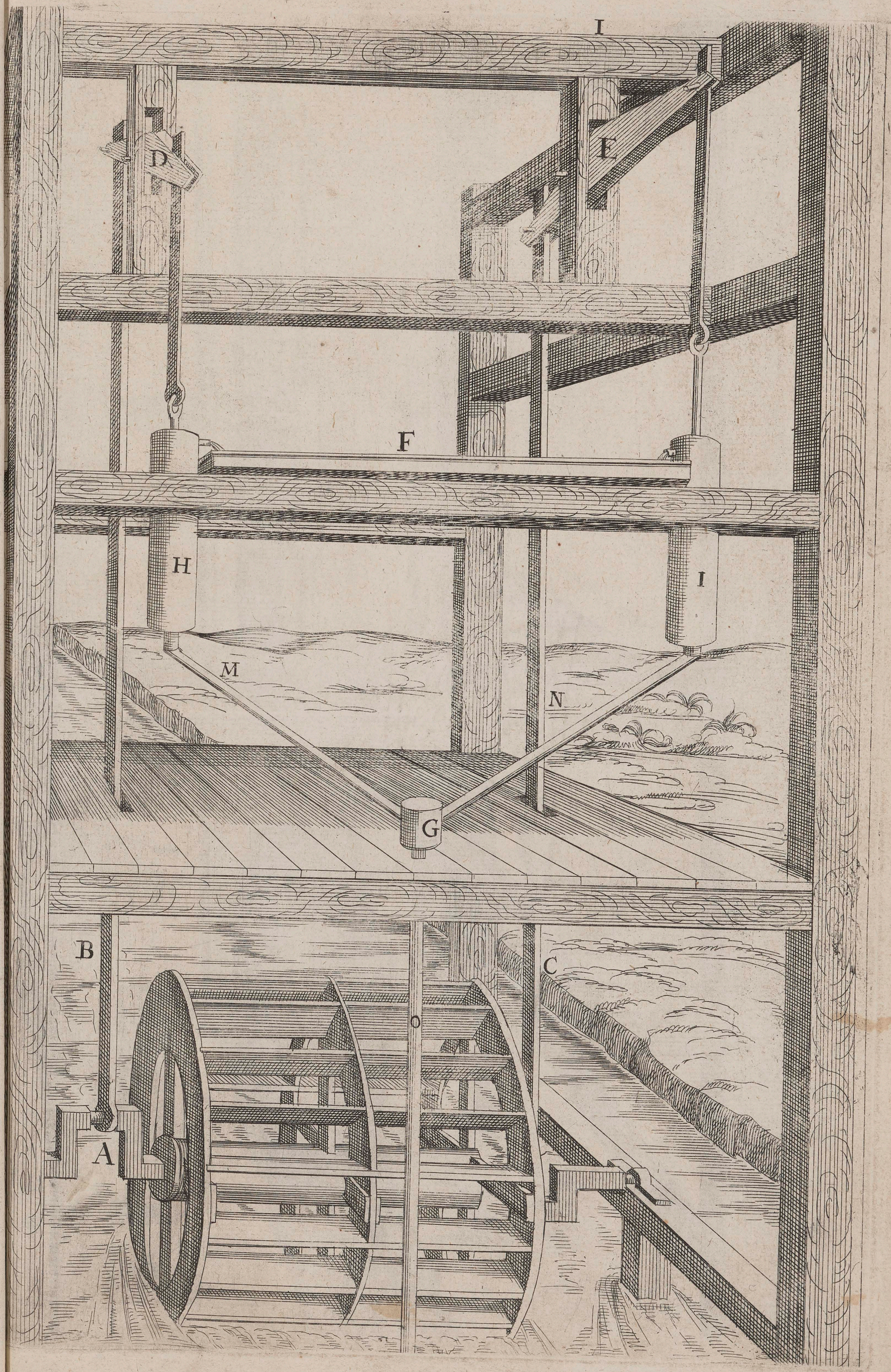
AMong all ſorts of Sluces which may be produced to retain the Water, and render Rivers and likewiſe ſmal falling Waters Navigable; I have obſerved this here to be the moſt excellent:

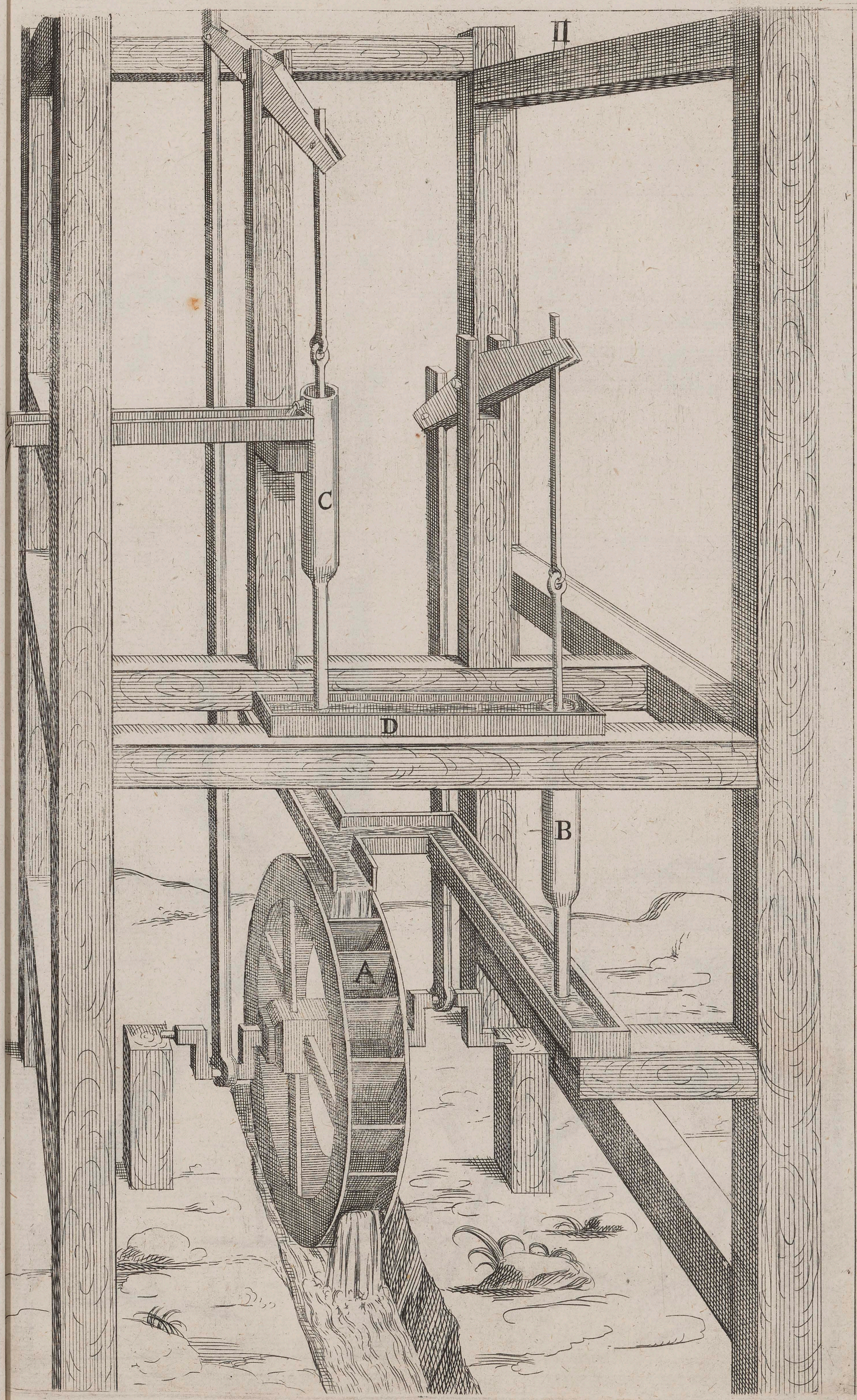
It is placed between *Venice* and *Padua*, upon the falling water which is between the two Cities, which by Art hath been rendered Navigable for the facillity of comers between the two Towns.

It is to be obſerved that the water A which is towards the Spring or Head of the falling Water is alwaies very much higher then the water B, which is at the bottom of the ſecond Sluce: Now to make the Boats and Barges Aſcend or Deſcend, they are tyed to an Iron ring during the time that the Water contained between the two Sluces Riſes or Falls; let it be ether to Aſcend towards A, or Deſcend towards B. The Ingenious Reader may eaſily ſee the effect of theſe Sluces, without more words, and making other deſcription then that which is deſcribed in the Figure.

The Explanation of Plate XXVI.

BEſides that which hath been handled before concerning Pumps, I have thought good alſo to add this manner of force-Pump, which is one of the beſt Inventions, and of which I have ſeen the experience: That which is here of great advantage, is that the forces do Riſe and Fall Perpendicularly in their Barrels: It is eaſy to comprehend by the Figure that there are four places in the Arber which are Hollowed or Channelled, and in the half of the Channels there are Pins A E, incountring with Pins which are in P H, they make them to Deſcend, and in Deſcending they raiſe B N without being hindered by the Pins that are therein, becauſe they paſs by the void place of the Channels marked with D C, and ſo they riſe and fall each in his turn, and force the water with great violence to 50, or 60. foot height, or higher, if it be required.


I
D
E
F
H
I
M
N
G
B
C
O
A


C
D
B
A

III

h

d

c

q

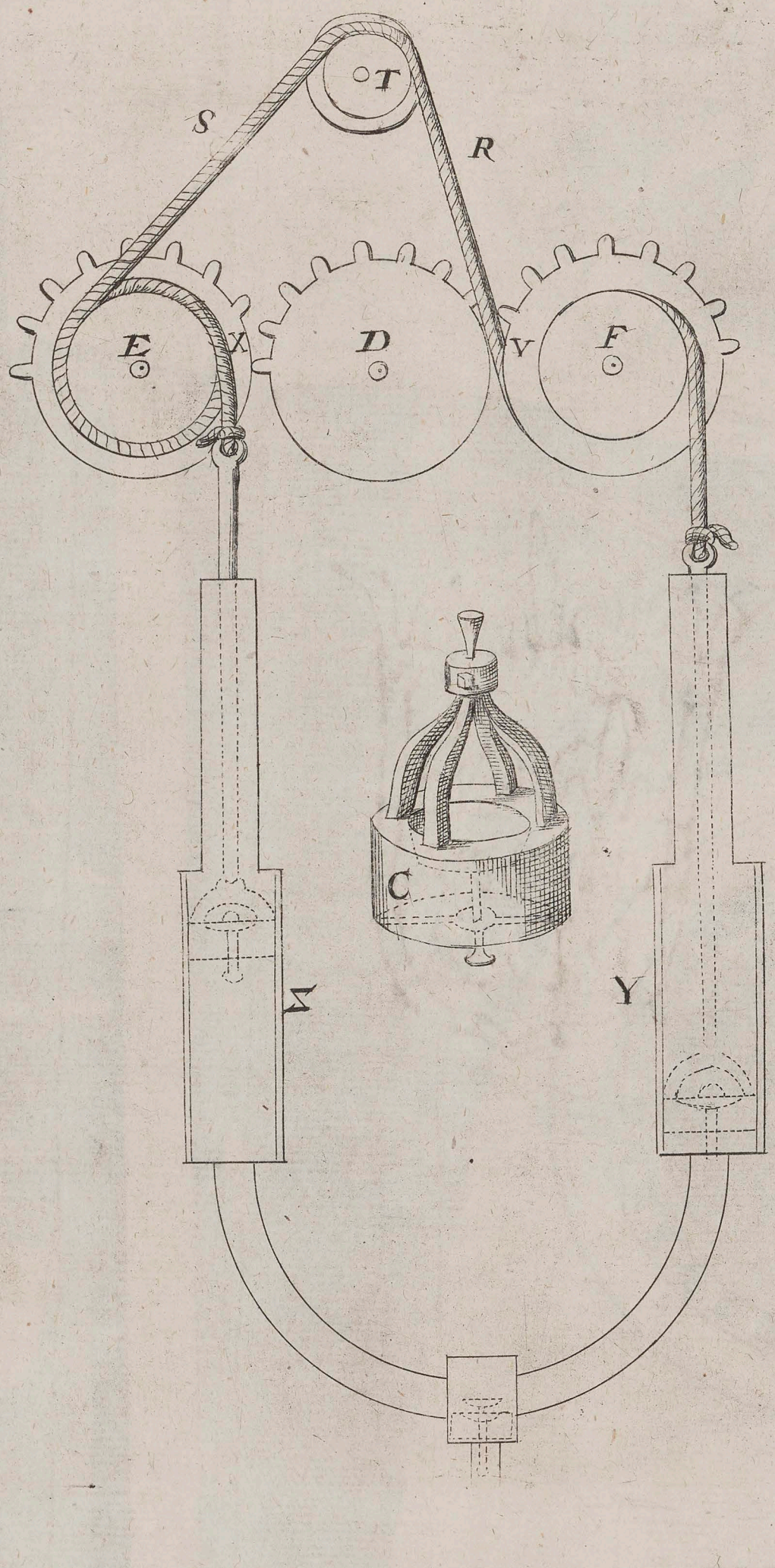
o

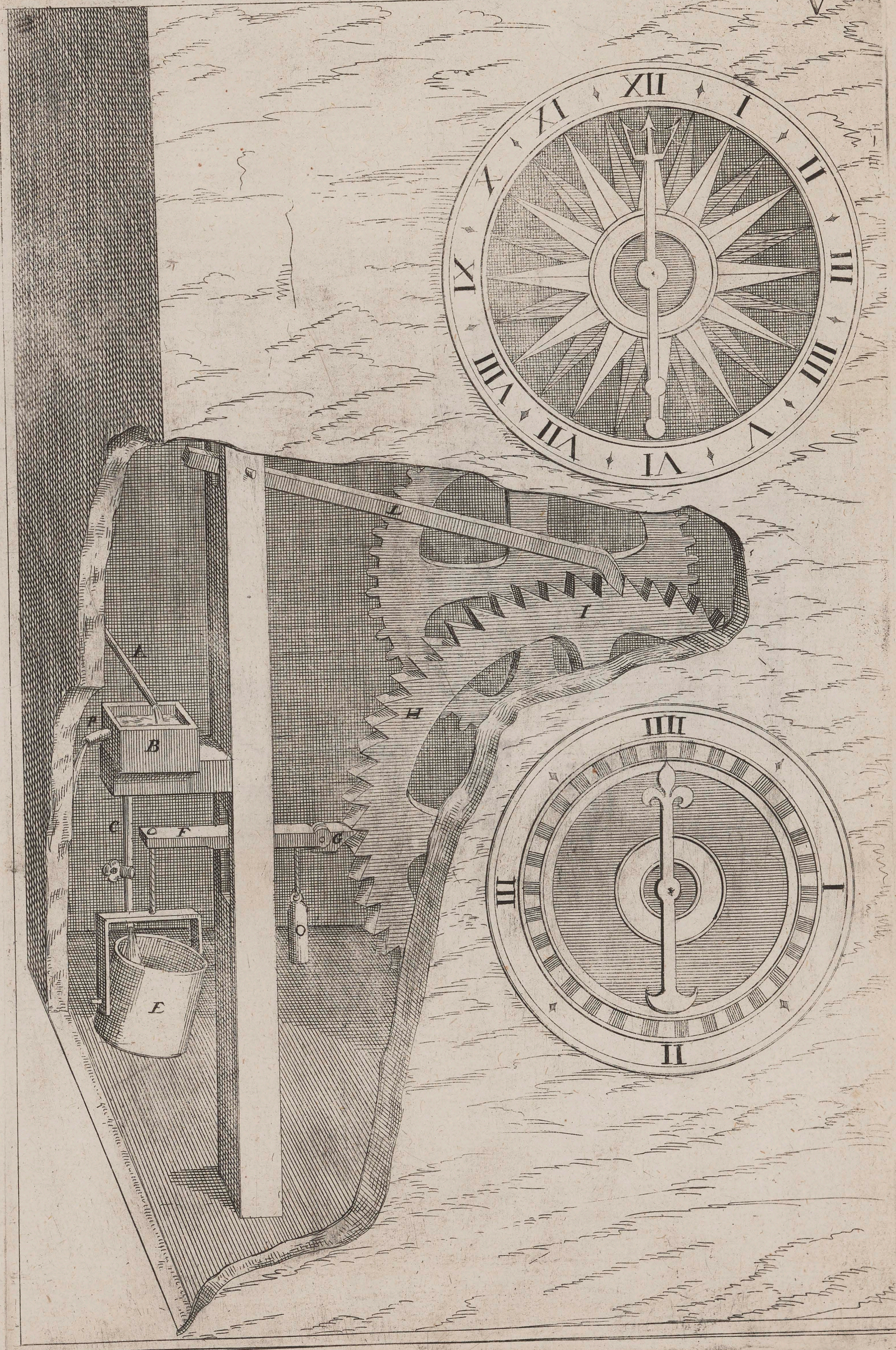
n

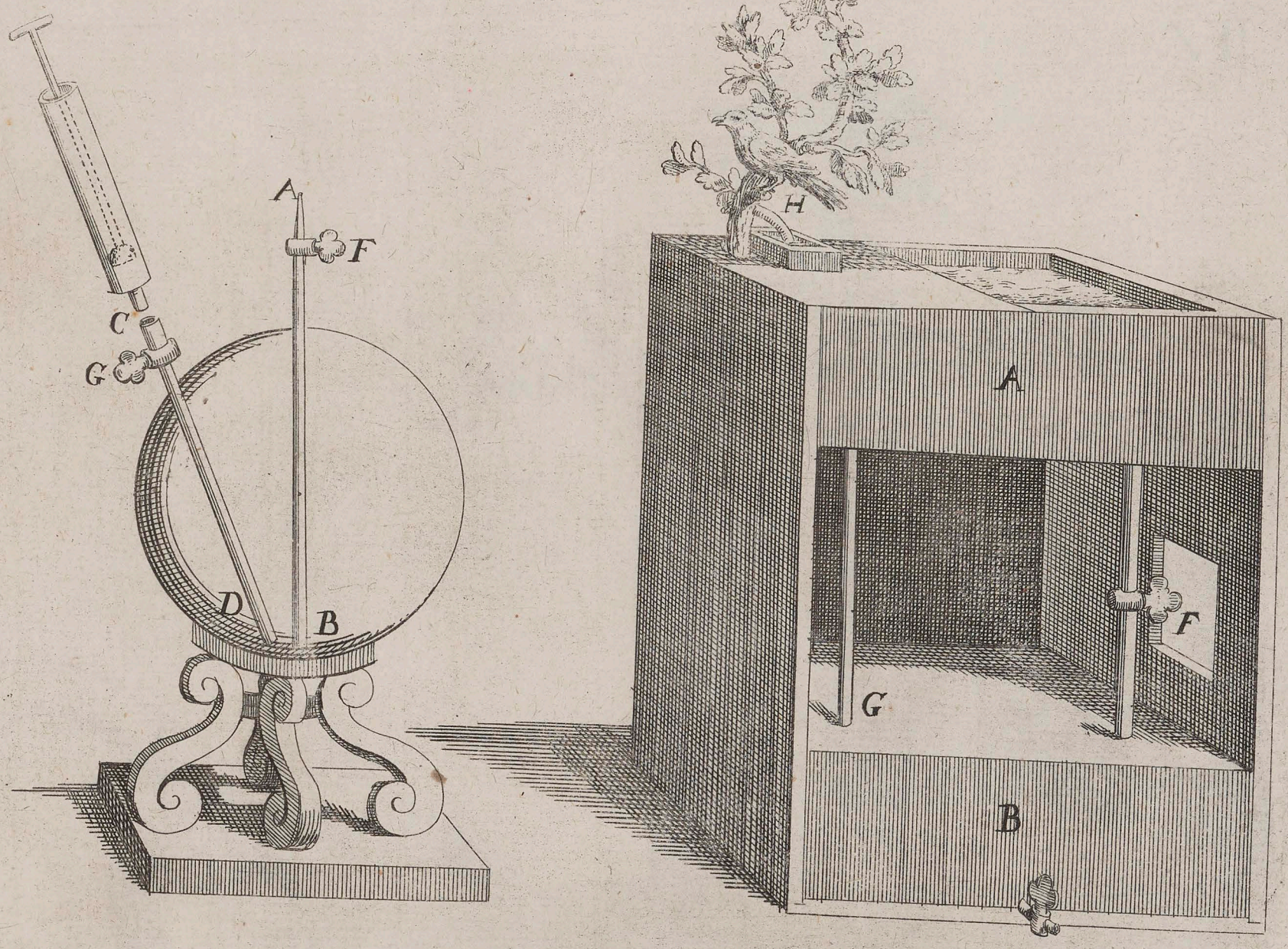
m

p

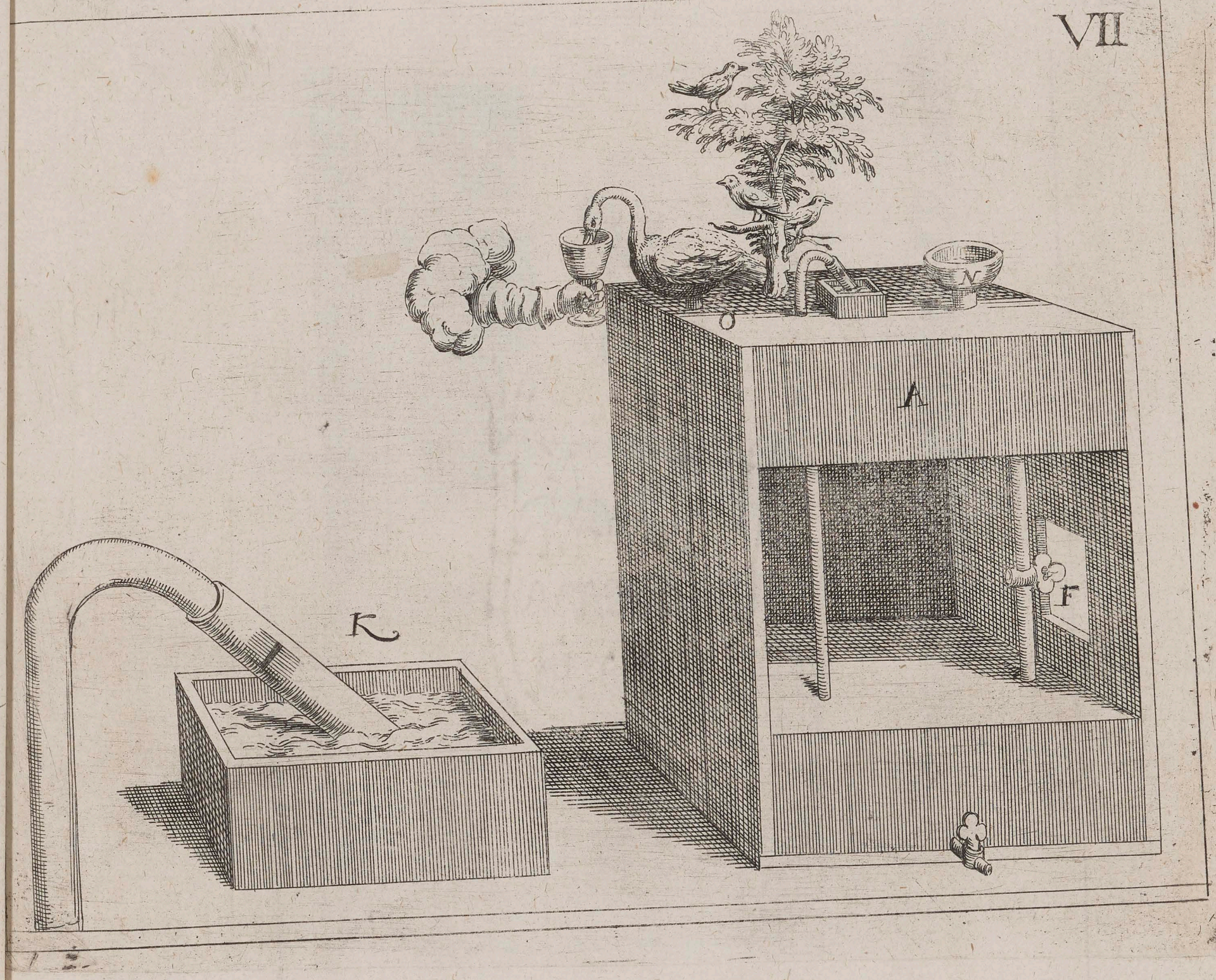
A

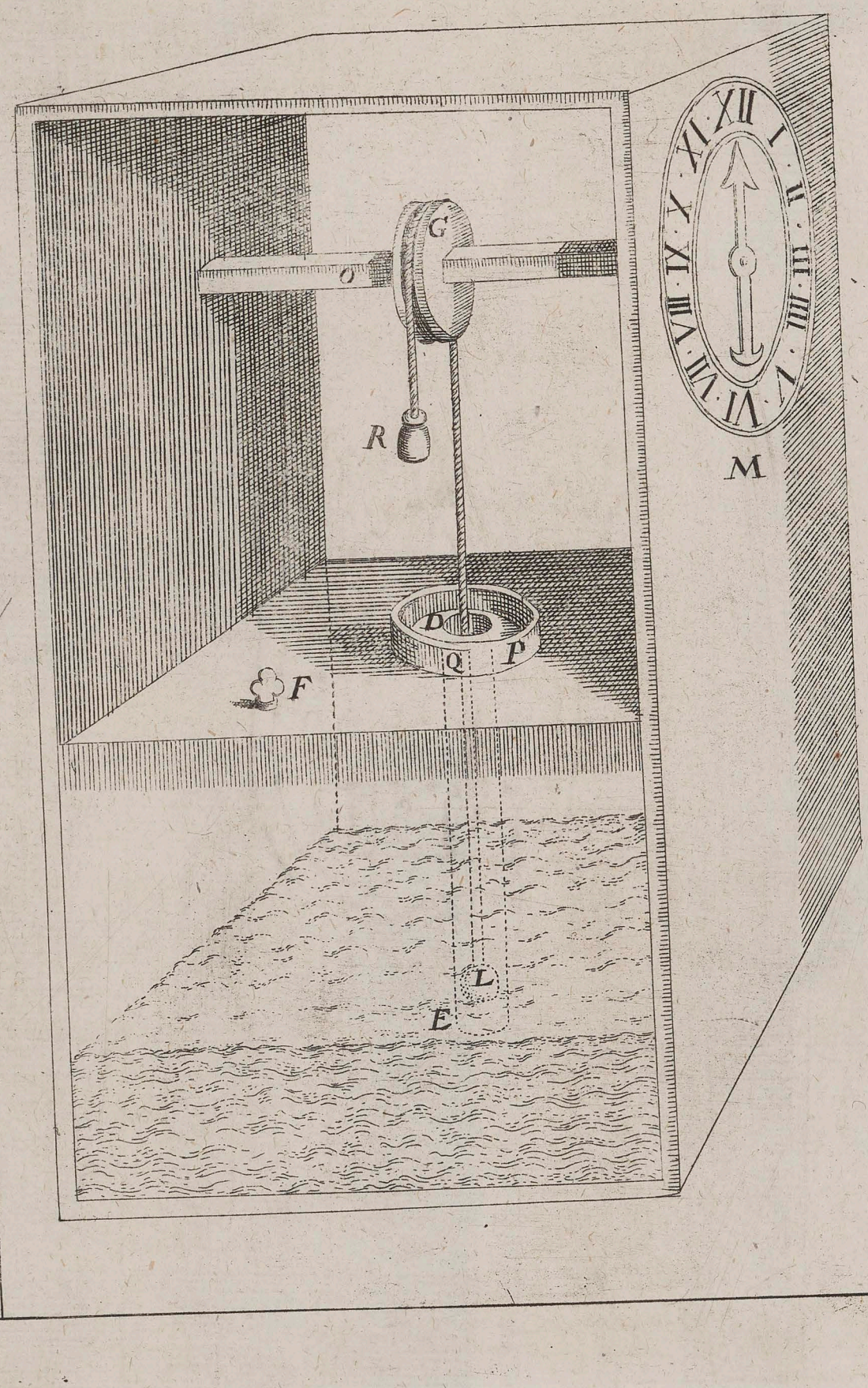

T
S
R
E
X
D
V
F
C
Z
Y

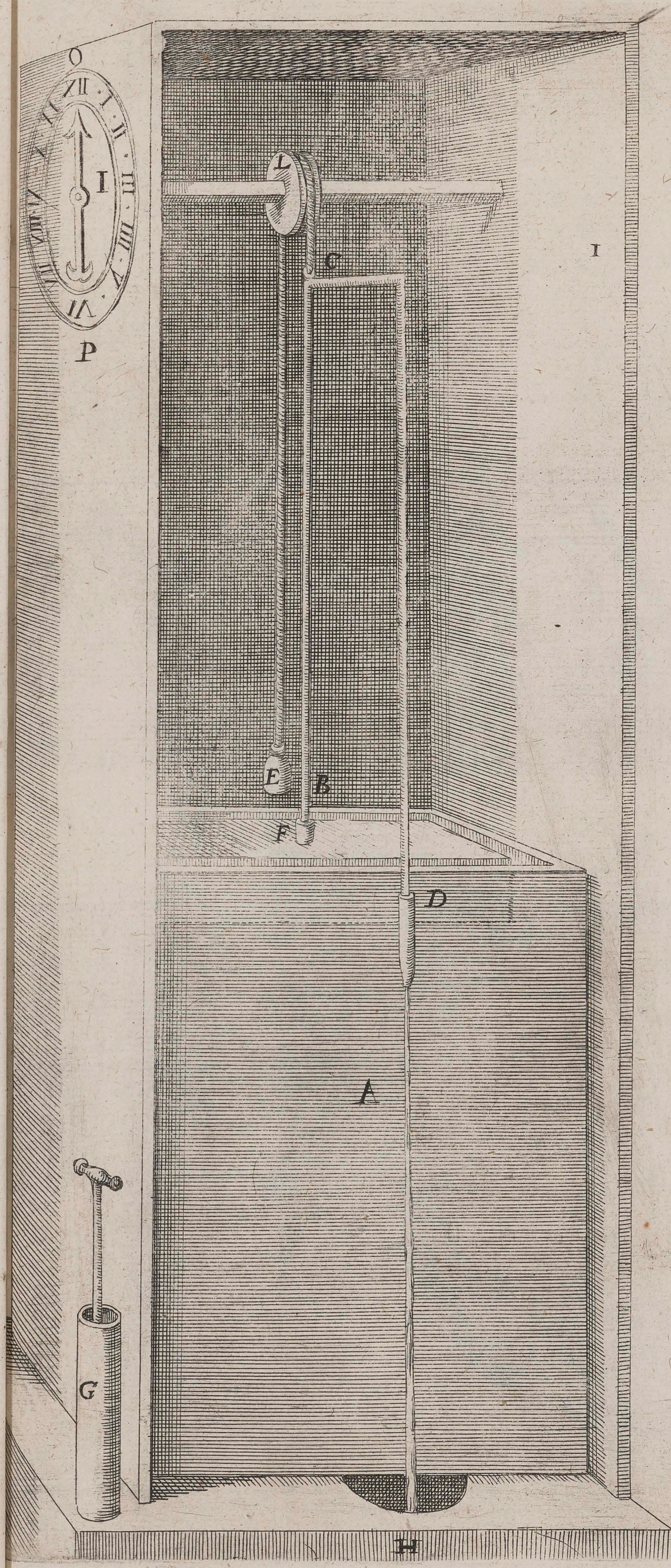

A
B
C
D
E
F
G
H
I
XII
I
II
III
IIII
V
VI
VII
VIII
IX
X
XI
IIII
III
II
I


A
F
C
G
D
B
H
A
F
G
B

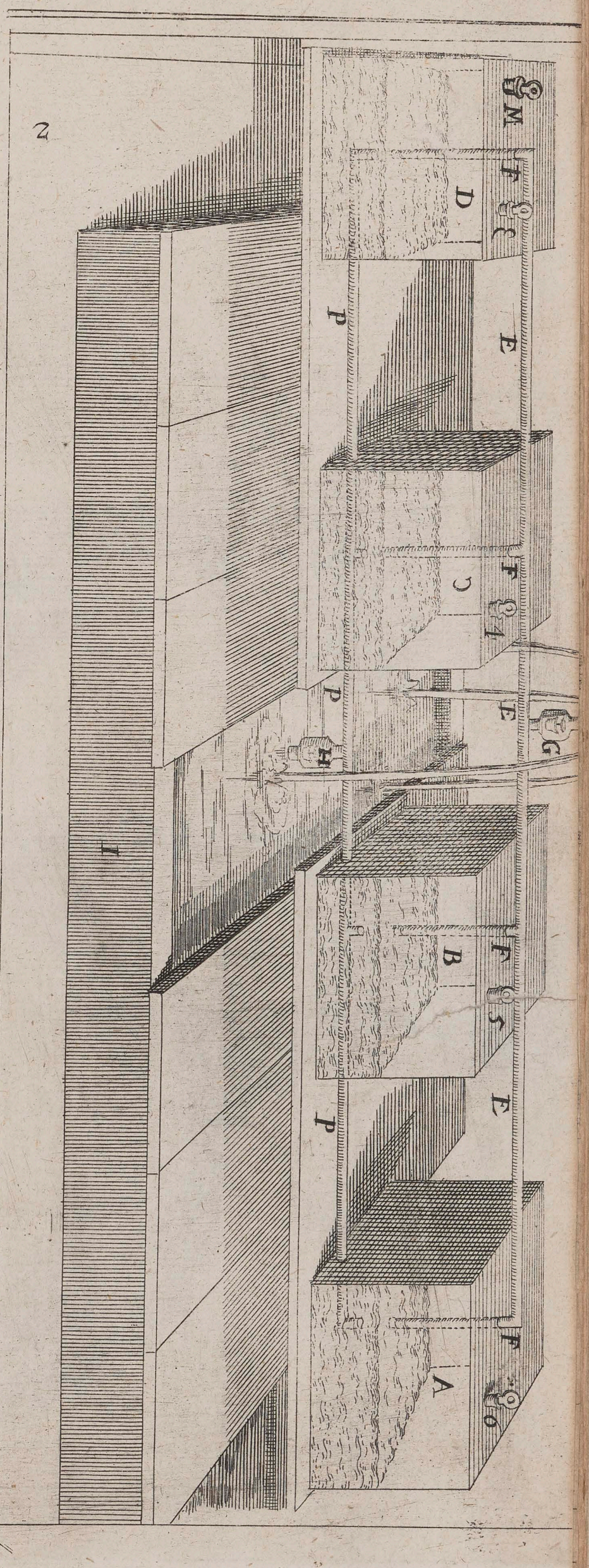
VII

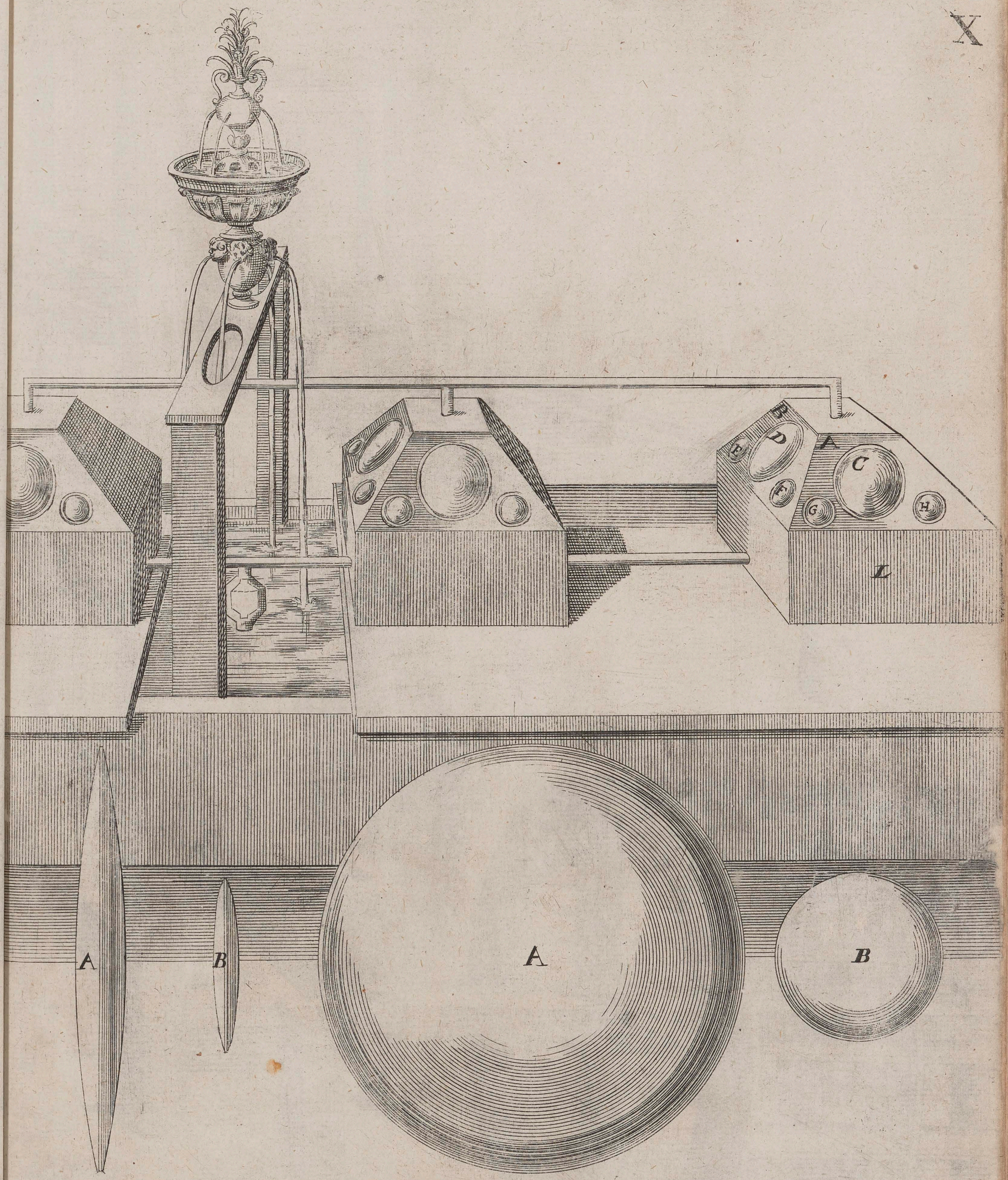


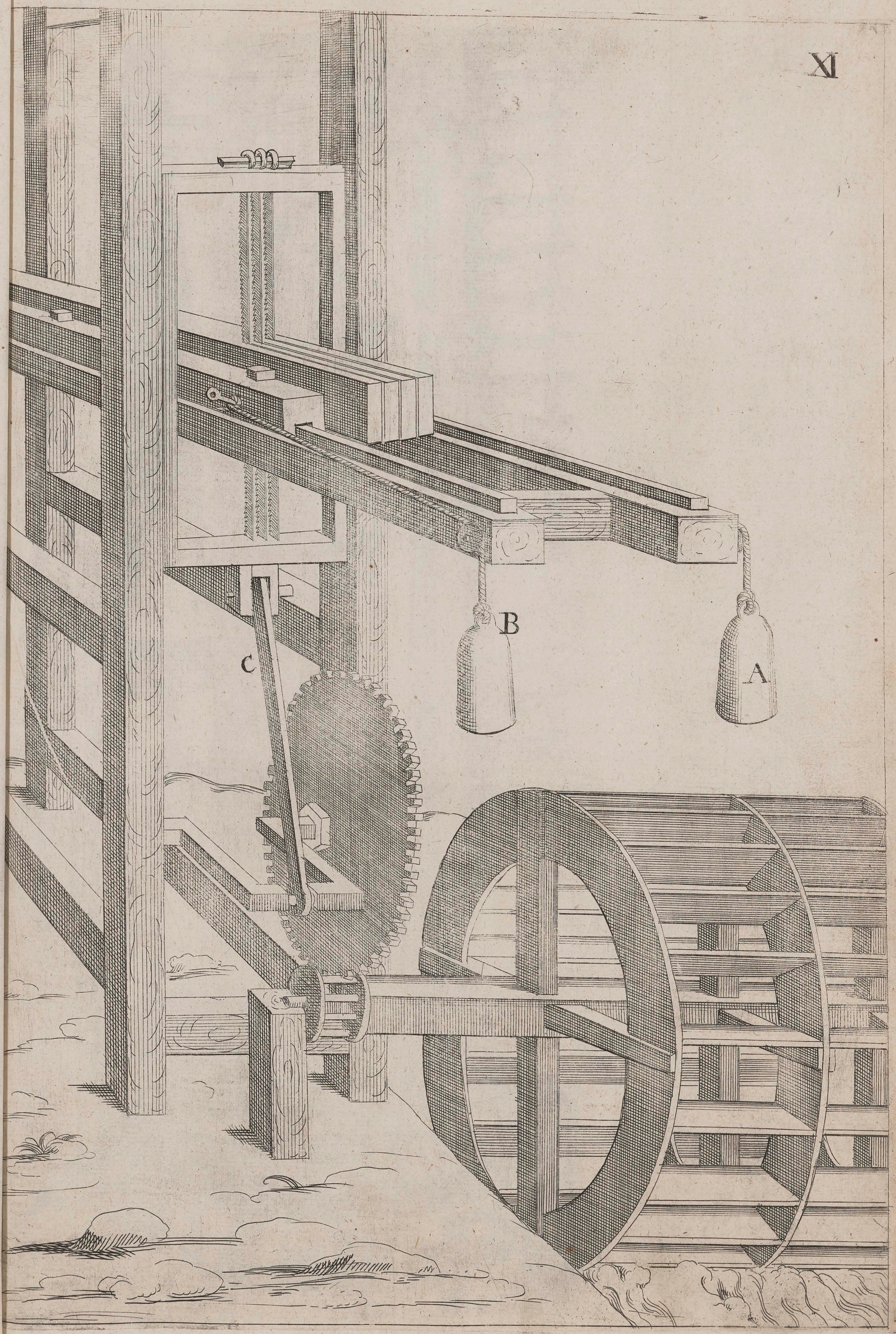

G
O
R
M
D
Q
P
F
L
E

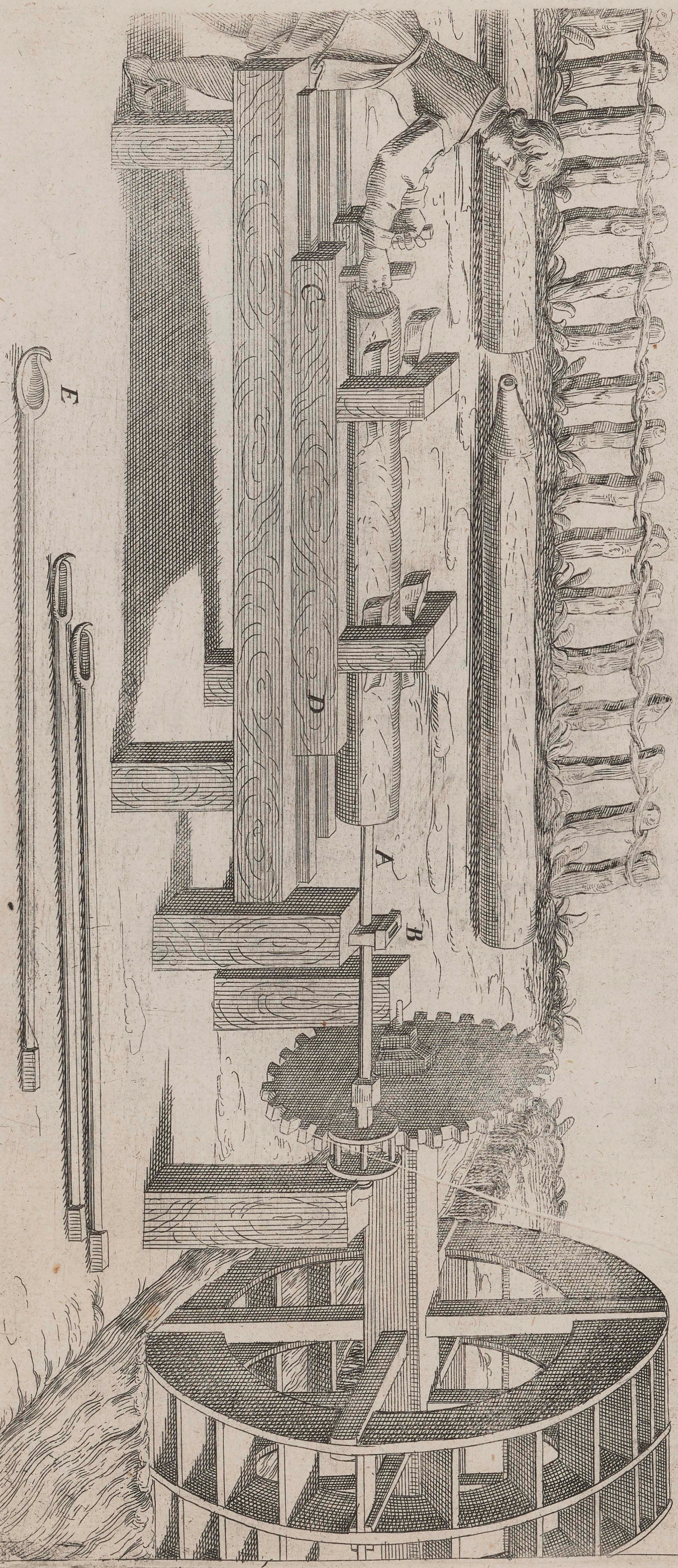


1

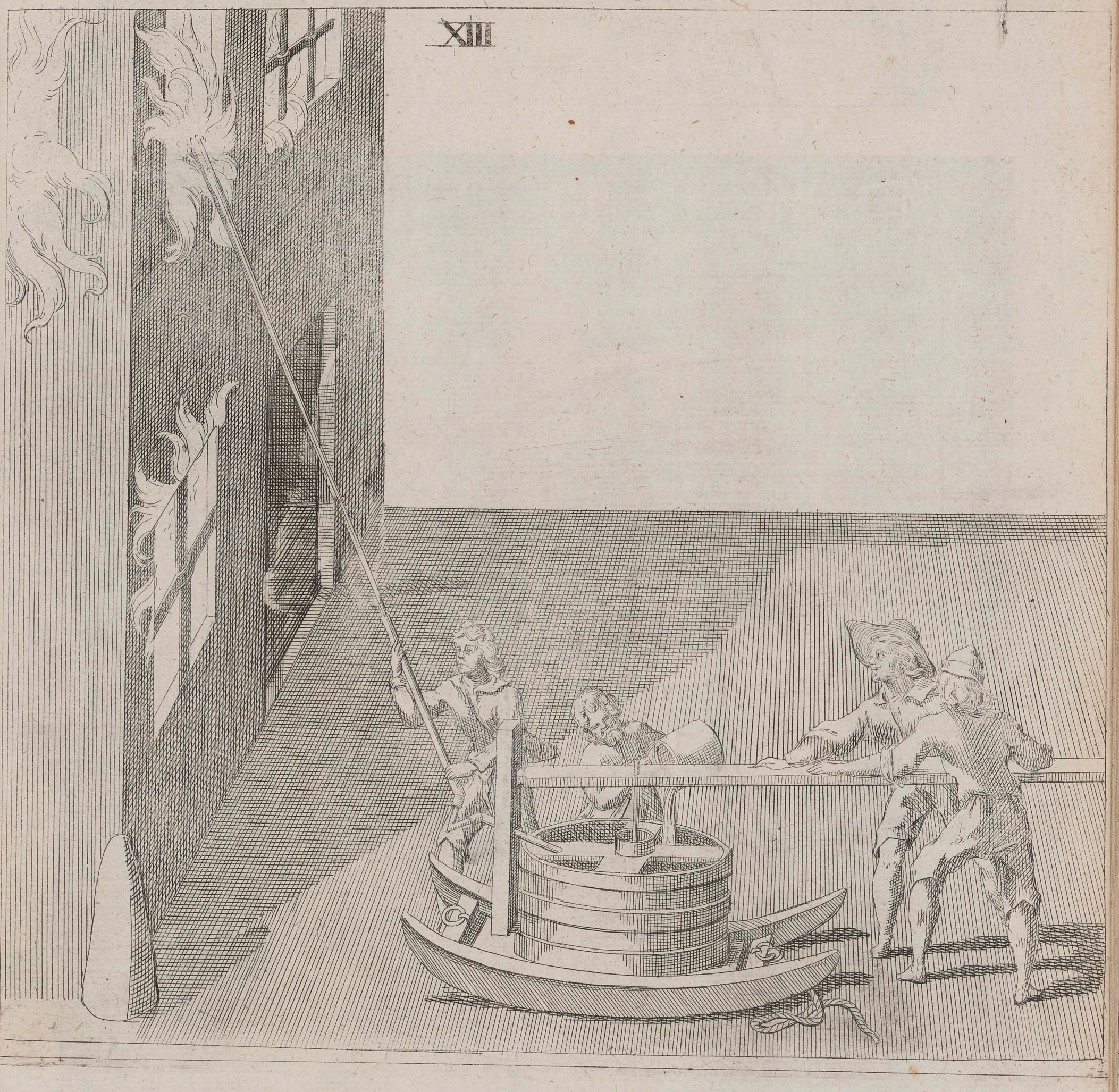


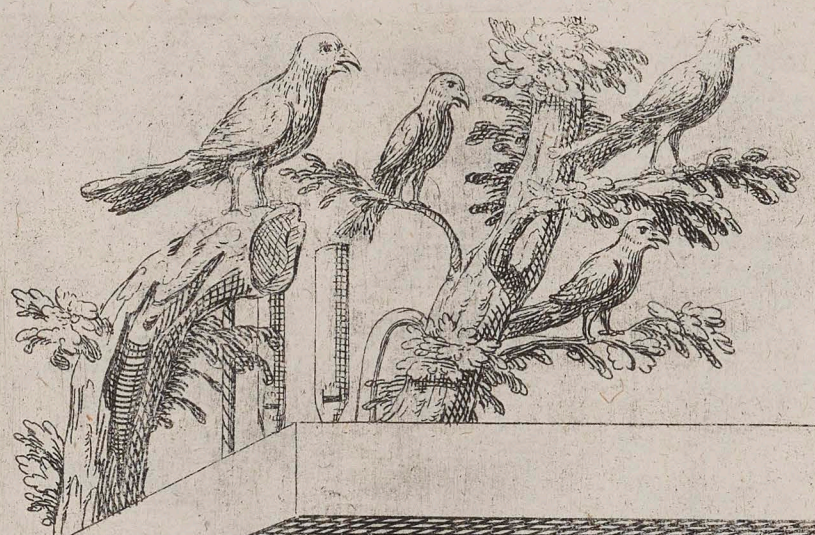

E
D
F
C
G
H
L
A
B
A
B

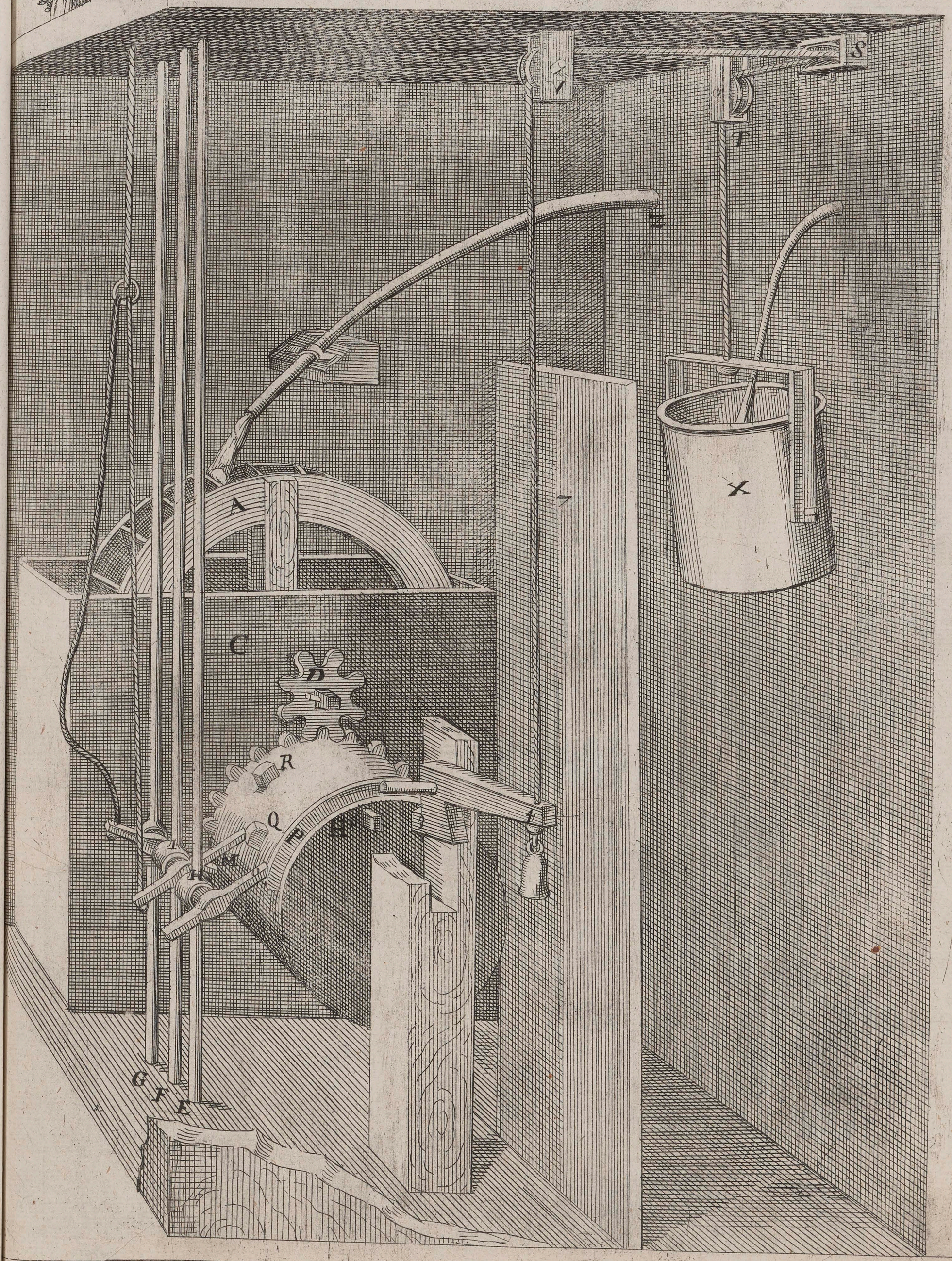

C
B
A

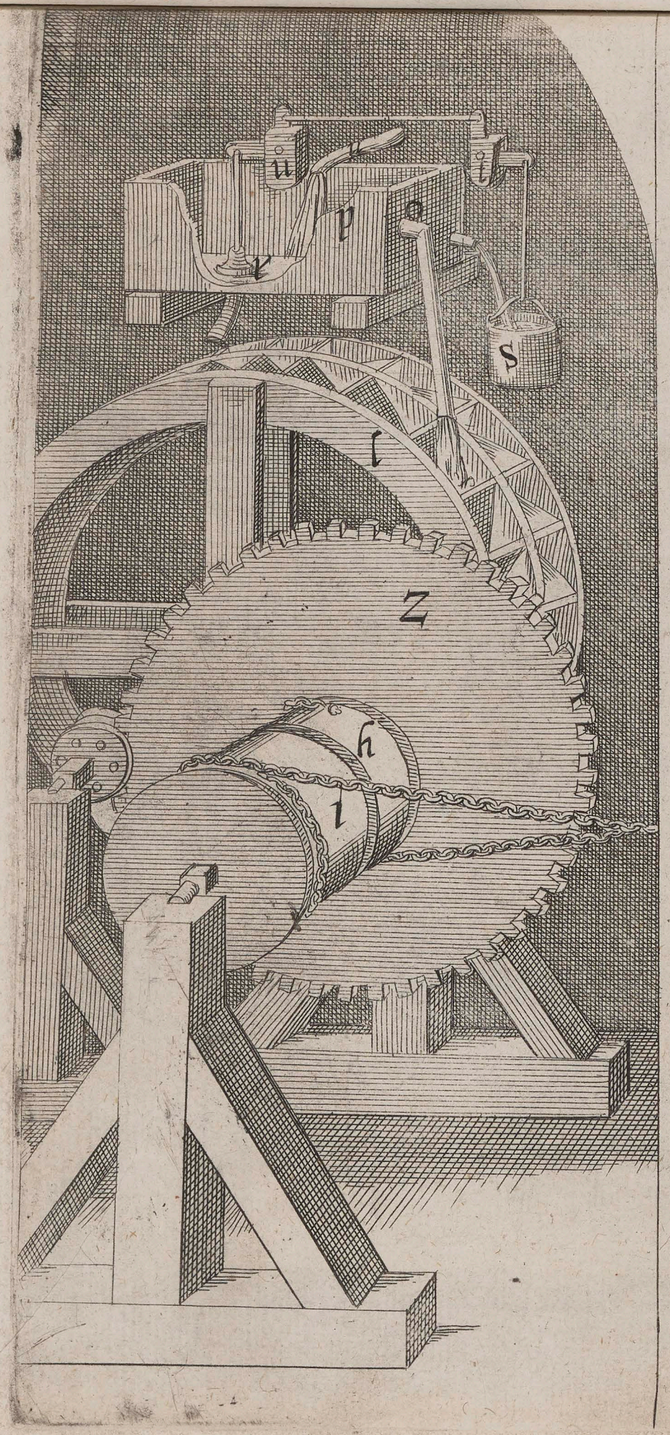

E
A
B
D

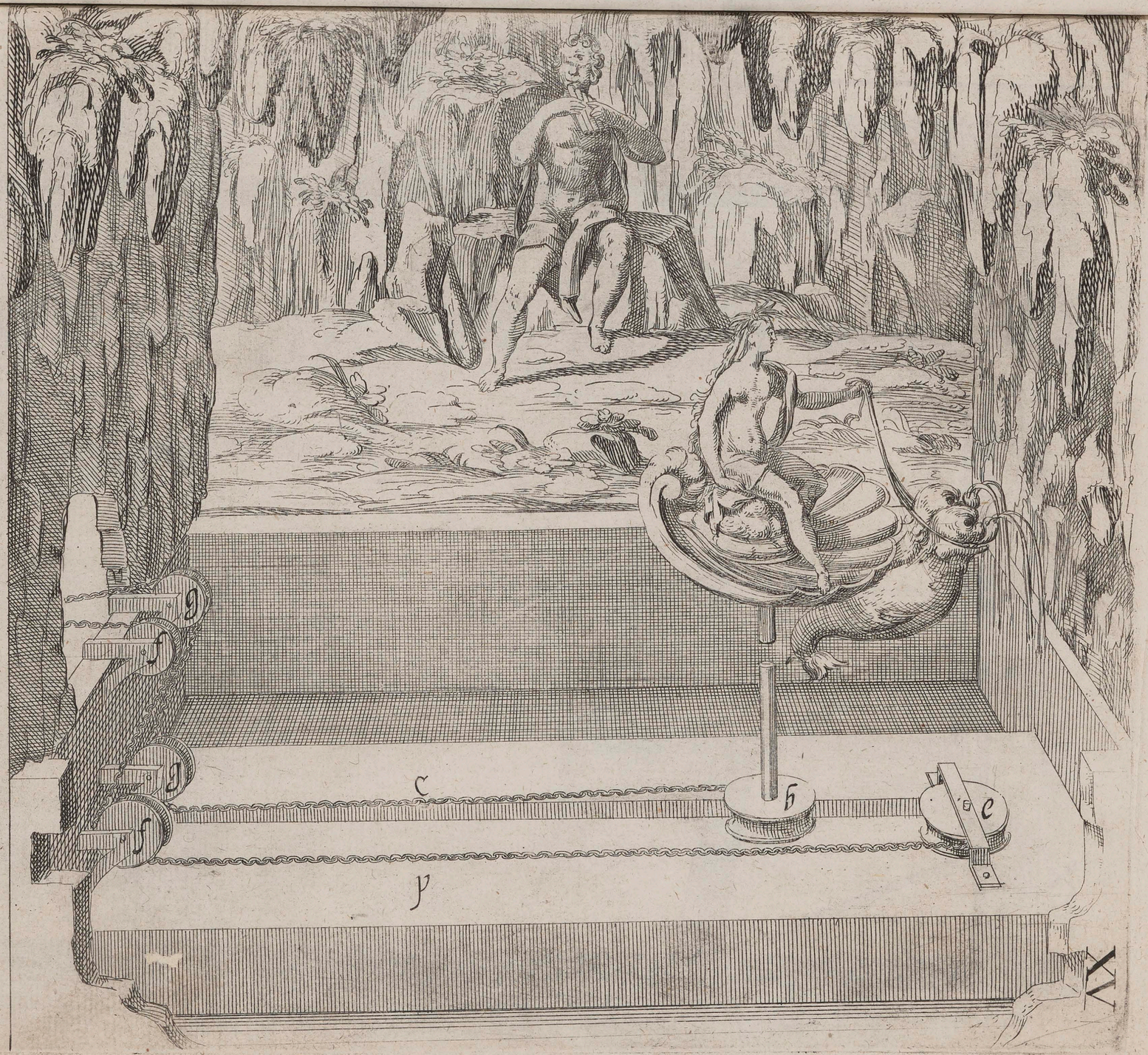
XIII





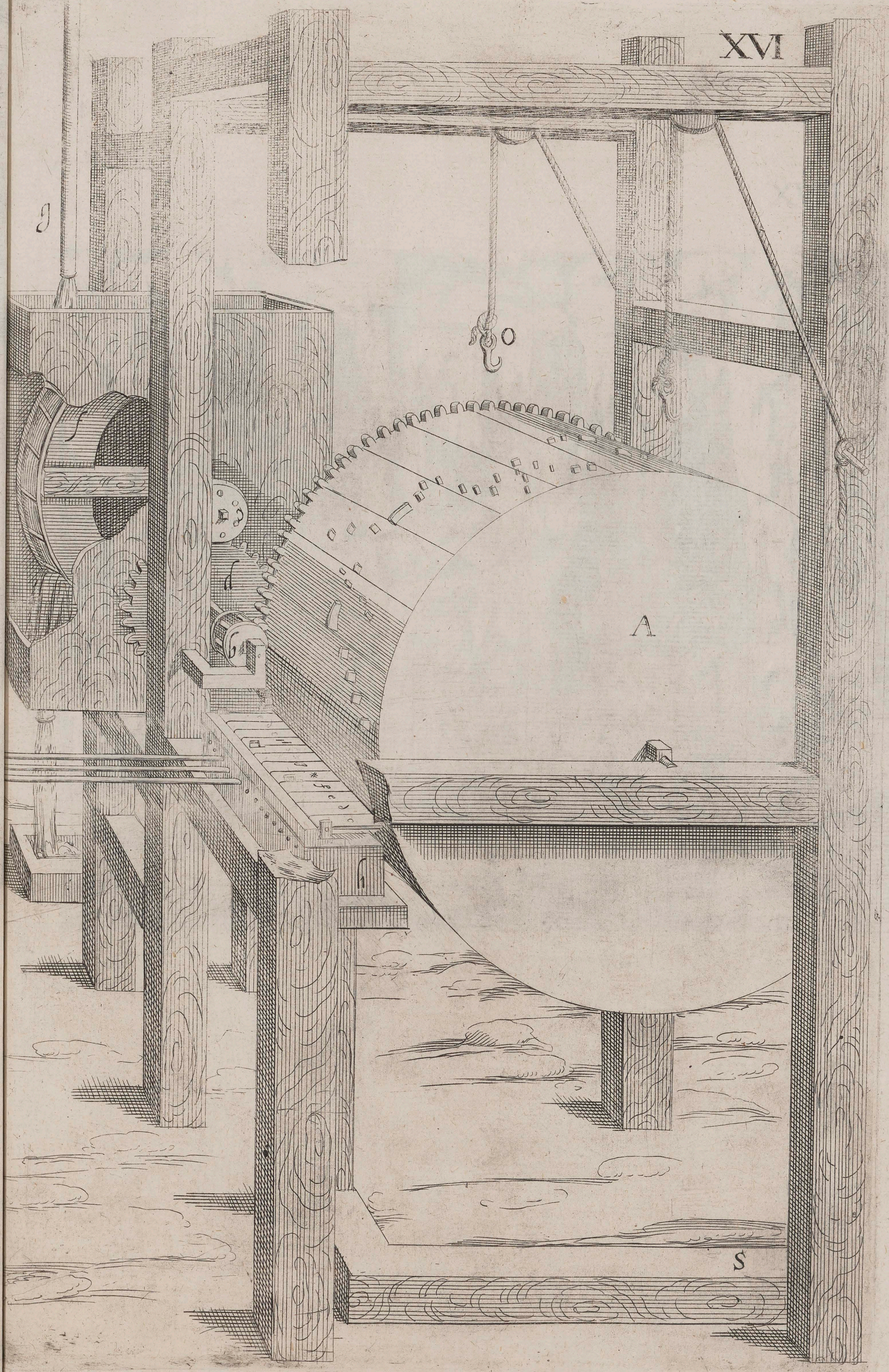

S
V
T
Z
A
C
B
R
Q
P
H
M
L
K
X
G
F
E



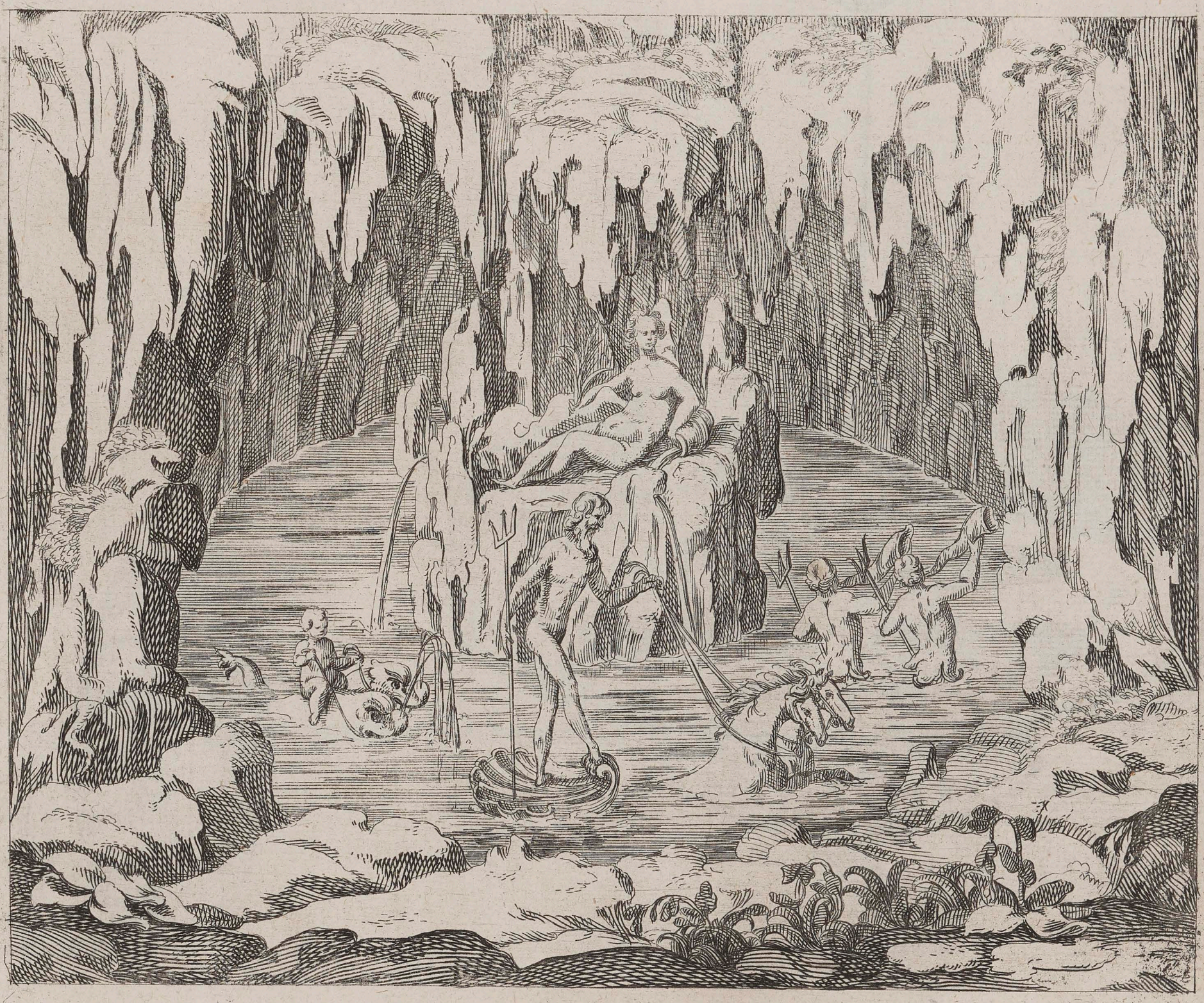


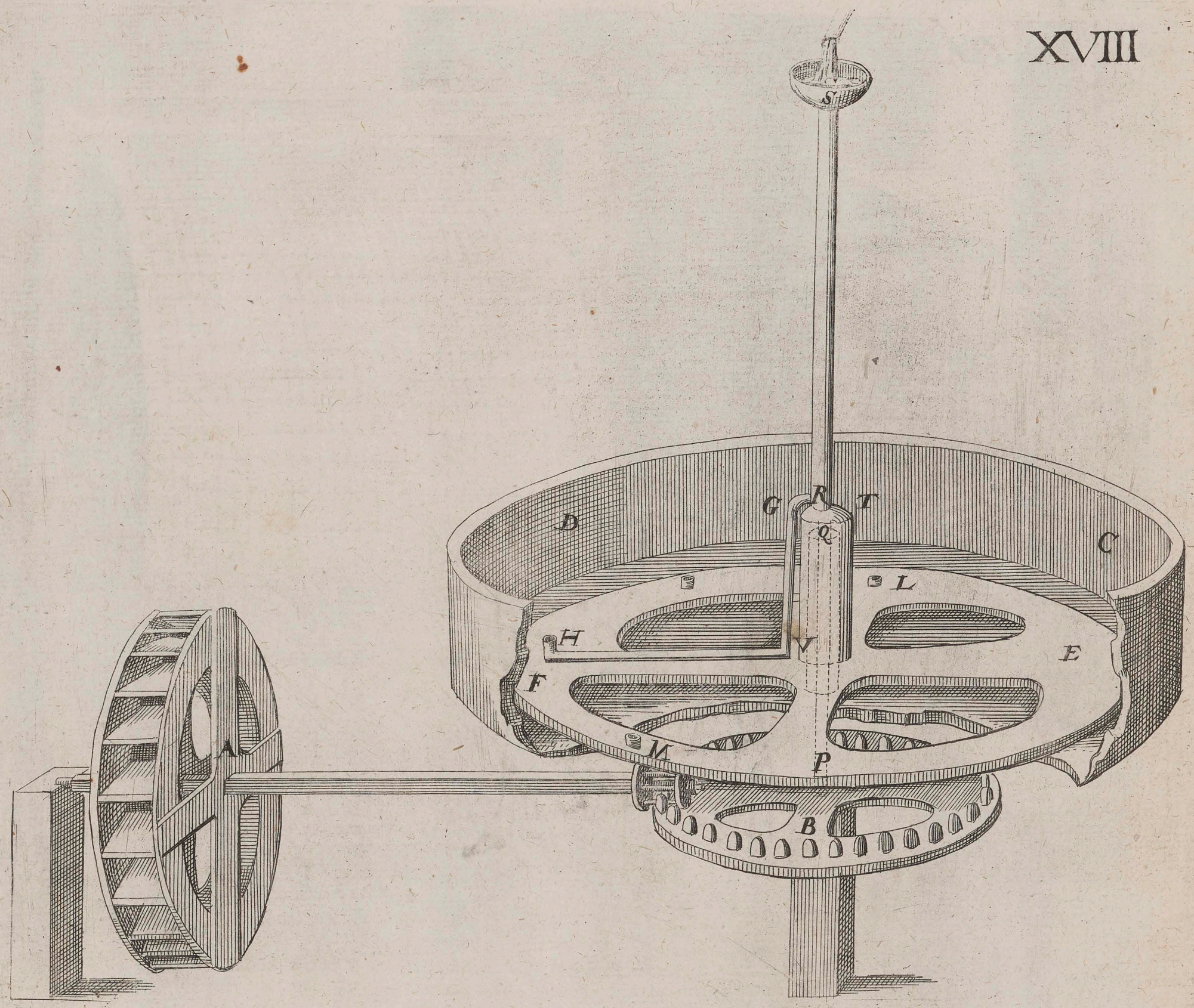
XV

XVI

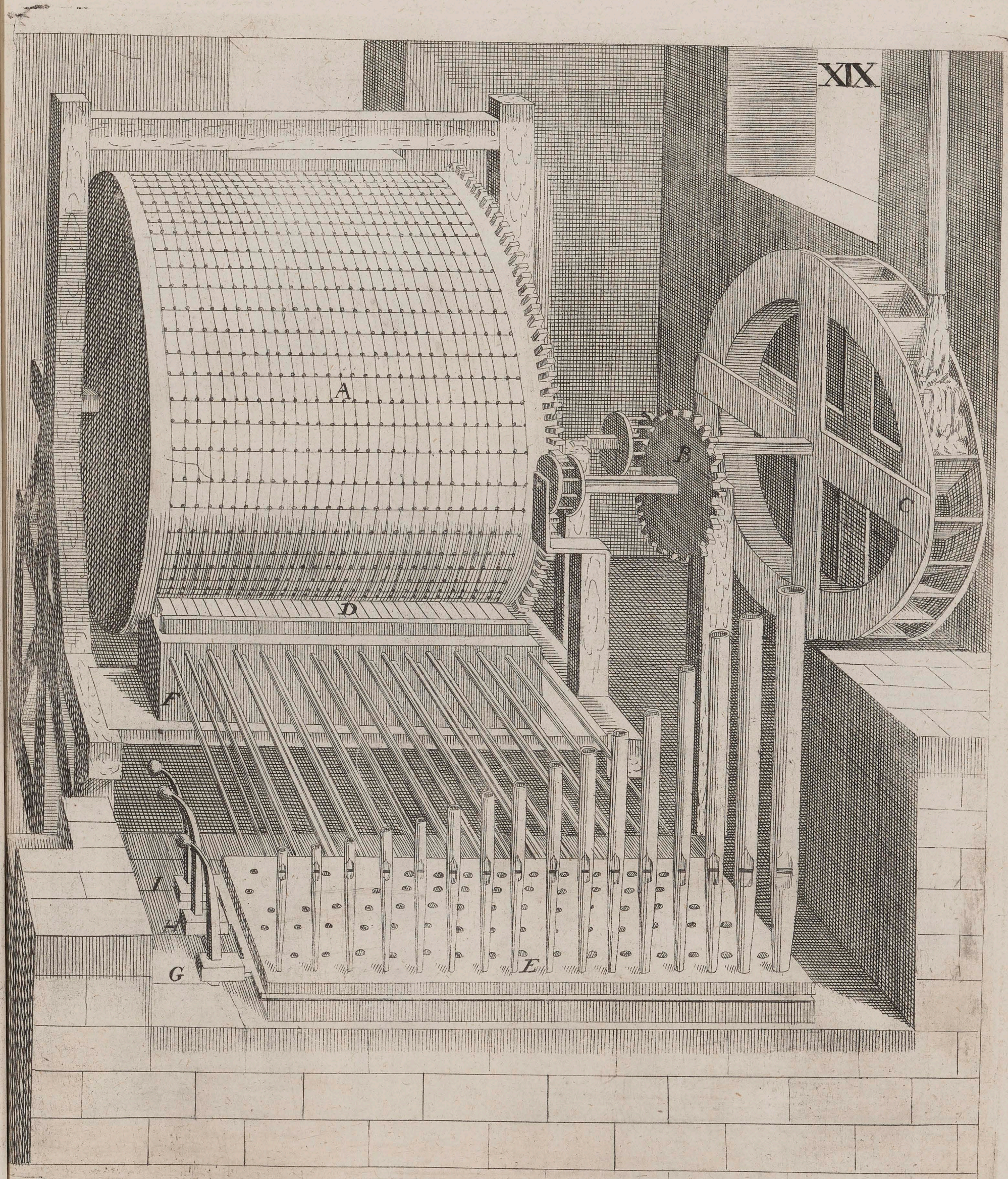


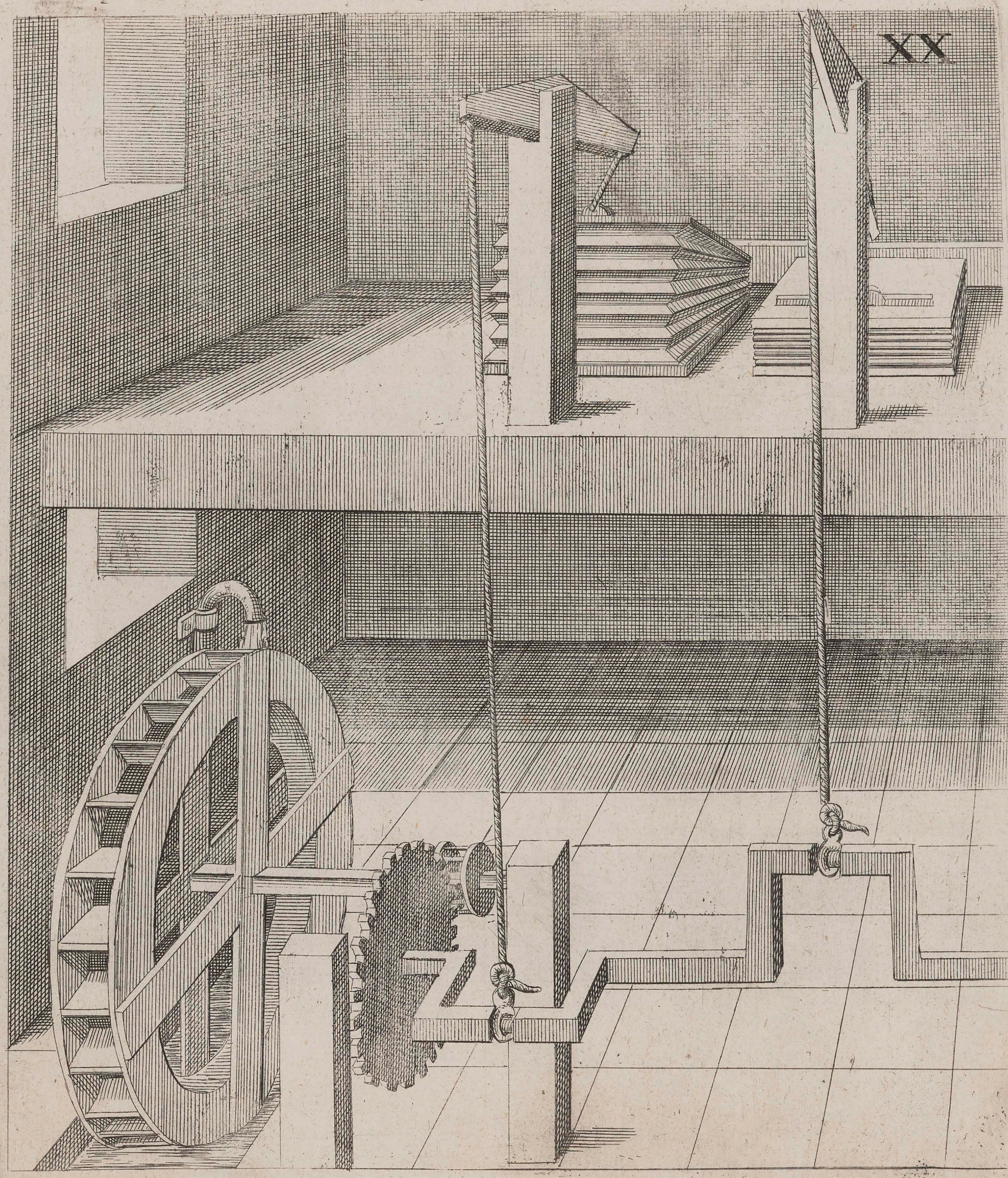
XVII




S
D
G
R
T
Q
C
L
H
V
E
F
M
P
B
A

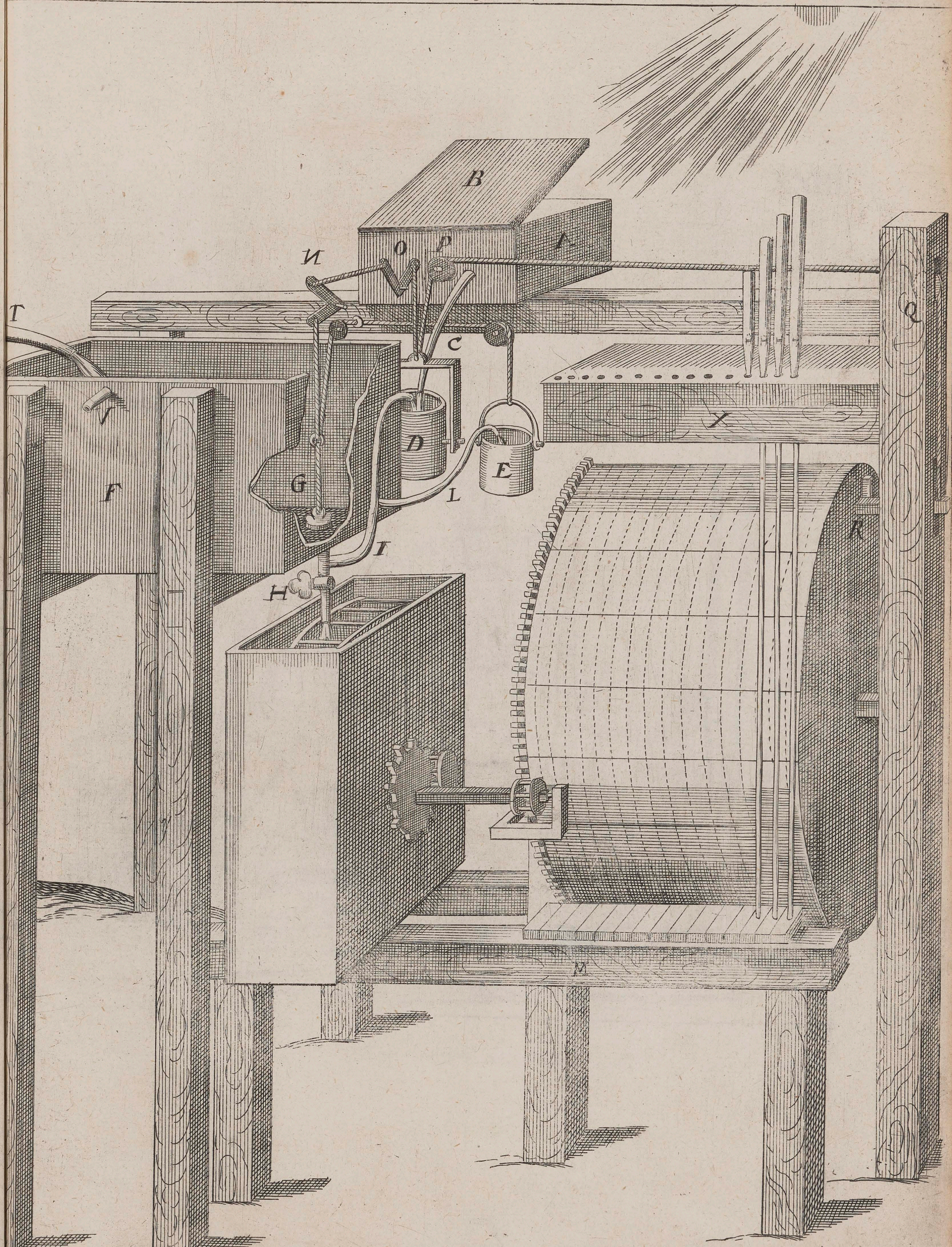
XIX



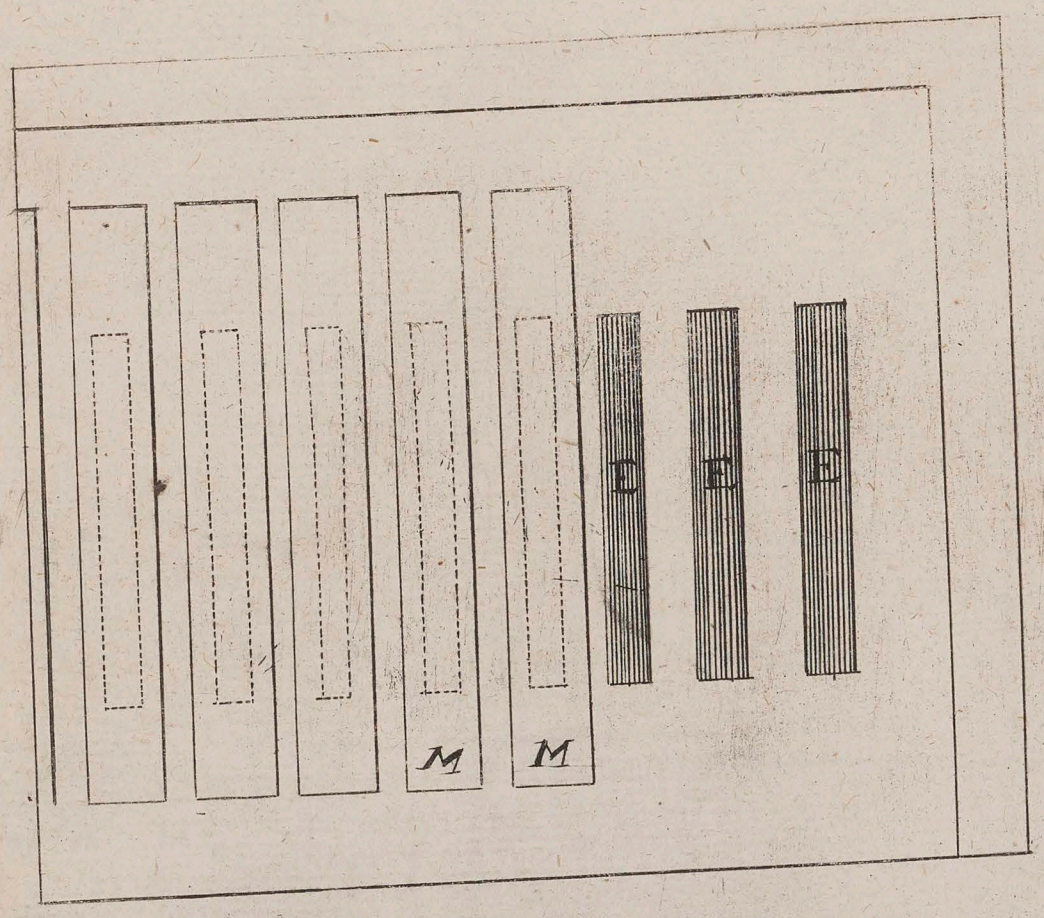

XX

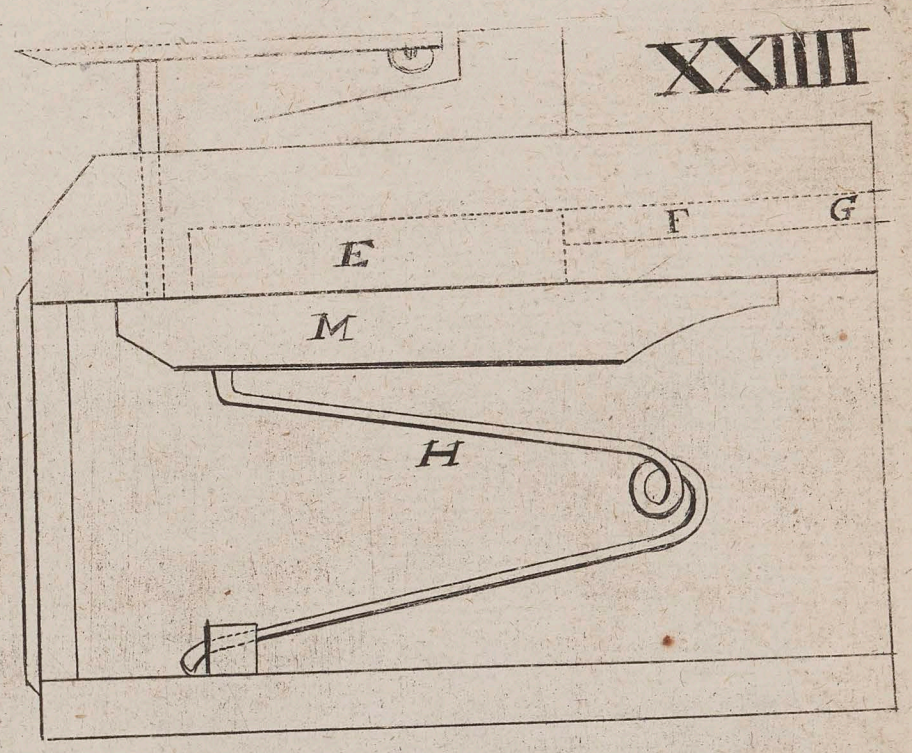
XXI

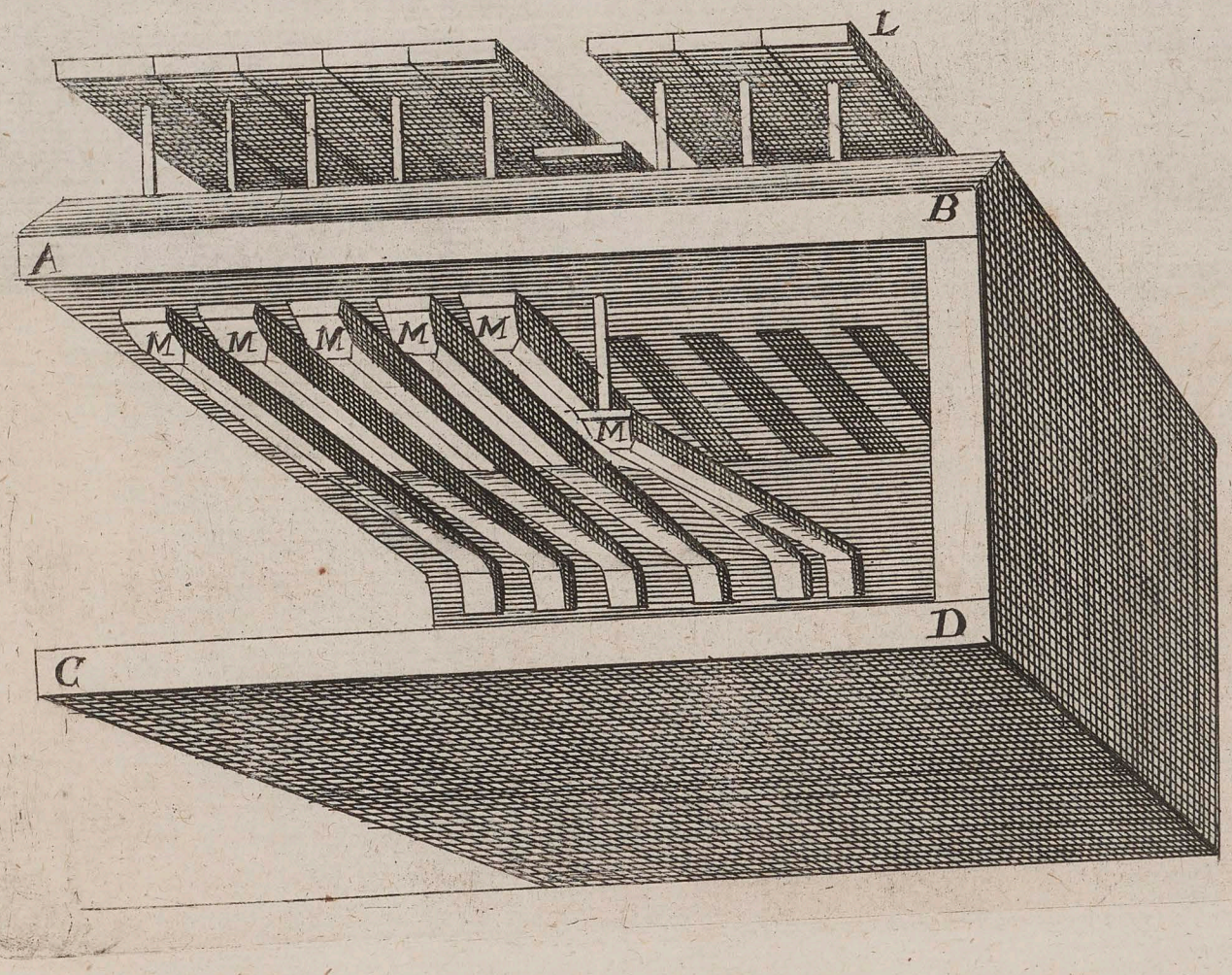
C D E F G A H C D F E F G A H C D


B
A
И
O
P
T
C
V
D
E
G
L
F
I
H
X
Q
R
M

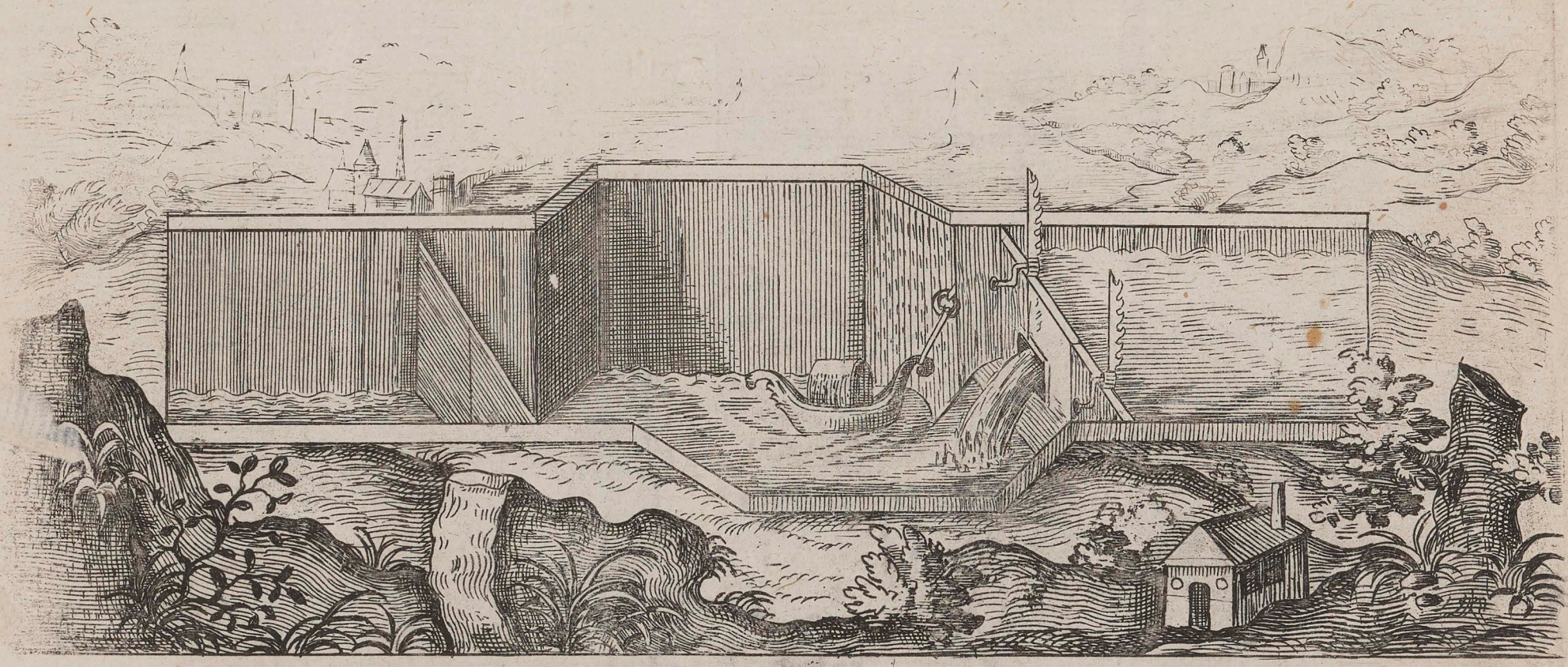
B
F
A
C

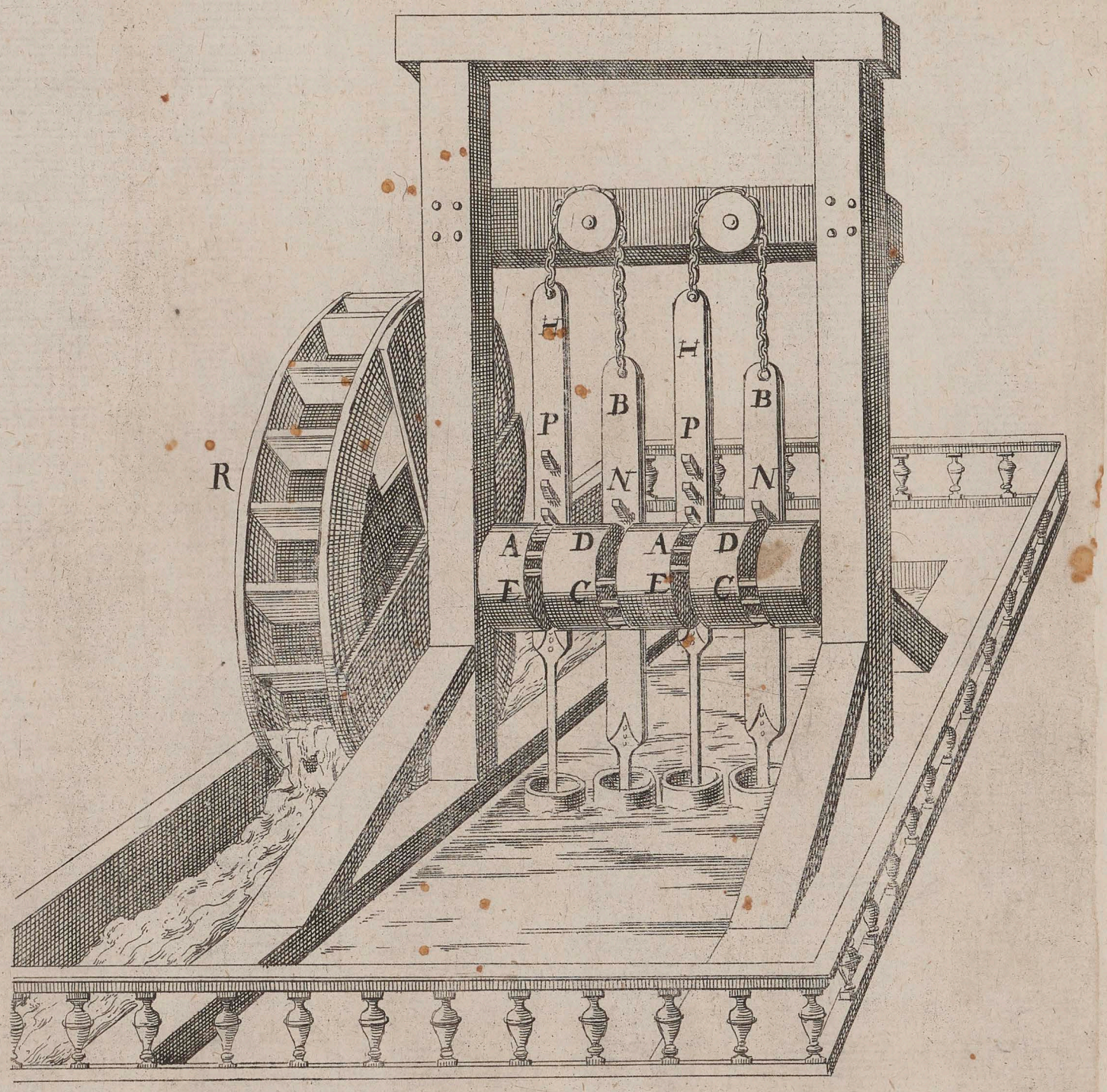

E
E
E
M
M


E
F
G
M
H


L
B
A
M
M
M
M
M
M
D
C

XXV




R
P
B
N
H
A
D
F
C